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KEY TO PRONUNCIATION.

ä	far, father
ā	fate, hate
a or ă	at, fat
ã	air, care
ạ	ado, sofa
â	all, fall
ch	choose, church
ē	eel, we
e or ĕ	bed, end
ė	her, over: also Fr. *e*, as in *de; eu,* as in *neuf;* and *oeu,* as in *boeuf, coeur;* Ger. *ö* (or *oe*), as in *ökonomie.*
ę	befall, elope
ë	agent, trident
ff	off, trough
g	gas, get
gw	anguish, guava
h	hat, hot
h or H	Ger. *ch,* as in *nicht, wacht*
hw	what
ī	file, ice
i or ĭ	him, it
i	between e and i, mostly in Oriental final syllables, as, Ferid-ud-din
j	gem, genius
kw	quaint, quite
ṅ	Fr. nasal *m* or *n,* as in *embonpoint, Jean, temps*
ñ	Span. *ñ,* as in *cañon* (căn′yŏn), *piñon* (pēn′yŏn)
ng	mingle, singing
nk	bank, ink
ō	no, open
o or ŏ	not, on
ô	corn, nor
ȯ	atom, symbol
ọ	book, look
oi	oil, soil; also Ger. ***eu,*** as in ***beutel***
ö or oo	fool, rule
ou or ow	allow, bowsprit
s	satisfy, sauce
sh	show, sure
th	thick, thin
ŧh	father, thither
ū	mute, use
u or ŭ	but, us
ú	pull, put
ü	between u and e, as in Fr. ***sur,*** Ger. *Müller*
v	of, very
y	(consonantal) yes, young
z	pleasant, rose
zh	azure, pleasure
′(prime), ″(secondary)	accents, to indicate syllabic stress

THE ENCYCLOPEDIA AMERICANA

S

SILK, Artificial. For many years manufacturers sought to produce a material which could be used as a substitute for silk. At the Paris Exposition in 1889 the Comte de Chardonnet exhibited a fibre having characteristics of true silk. This fibre was produced from cellulose of either cotton or pulp of soft woods, and after going through several processes could be spun and dyed like natural silk thread. Many other experimenters and inventors followed improving and modifying the Chardonnet method. Artificial silk is not so soft to the touch as true silk, nor has it the strength or elasticity. It is used largely for dress trimmings, hosiery, cheap ribbons and upholsteries; also for insulating electric wires and in the manufacture of incandescent mantles. It is claimed that Joseph Wilson Swann (q.v.) was the first one to attempt the production of artificial silk on a commercial scale. The consumption of this material in the United States in 1918 amounted to 5,801,221 pounds as compared to 4,683,543 pounds in 1915.

SILK AND THE SILK INDUSTRY. In this article it is proposed to trace briefly the history of the manufacture of silk, which has been throughout all the past an article of luxury, and which as late as the 3d century of our era commanded a price so great as to be beyond an emperor's wealth to purchase for his empress; but in our day has come to be within the means and ability of the great masses of our people, and a necessity instead of a luxury.

1. History.— Chinese appear to be the first people who applied themselves to sericulture, although some claim for the Tussur silk of India the earliest silk fibre used. The words *Seres* used by Theophanes and *Serinda* by Procopius were in all probability so used to indicate that part of the East, which was no doubt China, where the silk industry existed at a very remote period. Ptolemy was the first to use the word *Seres* for China, or rather the northern part of it, known later as Cathay; and the name is derived from the Chinese name of the silkworm, *sze, see* or *si*, in Korean *sir*, whence the Greek *σήρ*, the silkworm; *σηρες* the people who furnished silk; and *σηρικόν* silk. The Latin *sericum* has been traced direct to the Mongol *Sirkeh;* and the *Serikoth* of Isaiah, xix, 9, has been supposed to be silk. From *sericum* is derived the French *soie*, and etymologically connected with it are the German *seide*, Anglo-Saxon *seolc* and English *silk*. Hawae-nan-tze informs us, in a Chinese work called the ‹Silkworm Classic,› that Se-ling-shi, the principal queen of Hwang-te (2640 B.C.), was the first to rear silkworms, and the Emperor Hwang-te was induced to make robes and garments from this circumstance. The Chinese historians carry back the cultivation of the mulberry and the breeding of silkworms to the mythic period. If they are to be believed, the art of silk-reeling was known in China in the time of Fouh-hi, a century before the date traditionally assigned to the biblical deluge, and Hwang-te's queen did not disdain to share in the labors attending the care of the insect, as well as in those of the loom, the invention of which seems to be attributed to her and to have raised her to the position of a tutelary genius with special altars of her own. But whatever the precise date of the discovery, there can be no question of the very high antiquity of the knowledge of the worm and its product in China. A series of imperial edicts and voluminous literature of practical treatises testify to the importance of the industry and the care that was taken to foster an art which was considered, according to M. de Rosny, «best fitted to promote the morality of the people and extinguish pauperism in the empire.» The wives of the nobles through successive generations personally attended to the rearing of the silkworms. That this silk was of the mulberry-fed kind is evident from a further extract from the ‹Silkworm Classic› which says that afterward «When Yu regulated the waters (2200 B.C.) mention is made, in his work on the tribute, of the land adapted for the mulberry tree having been supplied with silkworms, from which time the advantage thereof gradually increased.» It is not known whether silk was utilized in India at so early a period as this; but that India learned the art from China is generally believed, although at what period is not known. Aristotle is the first Occidental to give a description of the silkworm, speaking of it as a horned insect, which passed through successive transformations and produced *bombykia*. Four hundred years later Pliny described the silkworm, but he knew nothing of its connection with the production of silk, which, he affirmed, was a woolly substance, combed from the leaves of trees and spun by the Seres. For 1,200 or 1,500 years after silk fabrics had become known in western Asia and eastern Europe, the prevalent opinion was, that it was either a fleece which grew upon a tree (thus confounding it with cotton), or the fibre from the inner bark of some tree or shrub; while some, deceived by the glossy and silky fibres of the seed vessels of the *Asclepias Syriaca* (milk-week), and of the silk-cotton tree (*Bombax*) believed it was the product of one or the other of these. A few had come so near the truth as to conjecture that it was spun by a spider or beetle. So carefully did the Orientals keep their secret that it was not exposed until the 6th century after Christ, when two Nestorian monks, who had been engaged in missionary labors in China, solved the mystery, by bringing to Constantinople a small quantity of silkworm eggs, concealed in the hollow of their palmer staves. The missionaries had observed in China the various processes connected with the rearing of silkworms, the nature of the trees on which they fed, and the preparation of the silk. This occurred in 552 in the reign of Justinian, who gave every encouragement to the introduction of the valuable insect. At the proper season the eggs were hatched and the caterpillars were fed on the leaves of the wild mulberry tree. The monks continued to superintend at Constantinople the rearing of the insects and the whole process of manufacturing the silk. This knowledge, thus made public, soon spread over the world and though the vast production of silk by the Chinese was not diminished, that of Europe and western Asia was greatly developed in the centuries that followed. Before the introduction of the silkworm in the West and while its culture still remained a Chinese secret the cities of Greece and Syria were compelled to pay so high a price for silk that their fabrics were sold ounce for ounce for their weight in gold.

From Constantinople sericulture spread over the Balkans and the looms of Constantinople, Athens, Thebes, Corinth, etc., were kept busy with the product. The Byzantine silk fabrics became famous and was much used for ecclesiastical purposes, vestments, etc. The Byzantine looms declined in the 8th and 9th centuries, but those of Thebes and other Grecian cities, as also of Syria increased their production and improved their methods of manufacture. The Greeks maintained their supremacy until the fall of the Eastern Empire in the 12th century; but the Arabs and Saracen princes carried their knowledge of the manufacture into northern Africa, Spain and Portugal and to Sicily. The production of Spain and Sicily was very considerable as early as the 11th century, and when the Normans conquered Sicily a century later they encouraged the silk industry. King Roger, first Norman king of Sicily, in 1146 invaded Greece and took captive a large number of silk-weavers whom he constrained to settle in Palermo and Calabria and to teach his people the Greek methods of silk culture. Venice and Genoa followed Roger's example in the 13th century. Other cities took up the new manufacture and Italy acquired a prominence in the industry which she has never wholly relinquished. About the 13th century silk began to be manufactured in France at Tours and later at Lyons. Not until 1494, however, did France engage successfully as a producer of cocoons. Successive rulers of France encouraged the industry but the revocation of the Edict of Nantes was a severe blow as it exiled about 400,000 Huguenots, most of whom were silk-workers. It was long before France recovered her lost prestige and then it was again wrecked at the Revolution. Under Napoleon I and the Bourbons a stringent tariff did much for the industry in France. The exiled Huguenots tried sericulture in England but without success until 1718 when a new method of throwing was introduced. The manufacture then received a new impulse and English silks replaced the French in the European markets. The English industry was ruined by the commercial treaty of 1860 which admitted French silks duty free. Switzerland and Germany also became competitors of France and are largely engaged in the manufacture of silk. Belgium and Holland have for several centuries engaged in silk production and the velvets and satins of Flanders are quite as old and of as good quality as those of the Italian cities. The manufactured silks of China, Japan and India have a character of their own and for some purposes are in demand. For raw silk production 1913–19 see table on page 6.

2. History of the Industry in the United States.— According to Chinese records the filament produced by the silkworm was first successfully woven by Si-ling-Chi, empress of China, in 2700 B.C., but it was not until the 6th century that the art of making silk was introduced in Europe. In 1609 James I brought the silkworm and the mulberry tree into England and shortly after this the company of Virginia was formed by a group of Englishmen to promote the silk industry in the colonies of America.

The first expedition sent to America met with disaster. Four years later a more successful beginning was made. Influenced by the Crown the Colonial legislatures passed an act requiring 10 mulberry trees to be planted on every hundred acres. There was a fine for neglect of this duty and a premium for every pound of silk produced. But the most strenuous effort amounted to little. With the ascension of a new king to the British throne in 1666 all acts giving bounties for silk or requiring mulberry trees to be planted in Virginia were repealed, and an interlude occurred in sericulture until the last years of the century when several French Huguenots settled in South Carolina. These were skilled silk workmen and they were in earnest in their endeavor to cultivate it in profitable quantities. At about the same time another colony was formed in the same province which was known for more than a century by the name of Silk Hope.

During the first 35 years of the 18th century the silk industry was also introduced into Louisiana and Georgia. Silk culture by the colonists, however, had a fitful and uncertain existence. From 1750 to 1772 the period of its greatest activity before the Revolution, the export of raw silk averaged only 500 pounds per annum, and rarely exceeded 1,000 pounds in a single year.

For many years after the Revolutionary War premiums and bounties for planting mulberry trees and for producing raw silk were authorized by a number of the States. In December 1825 the subject of silk culture received national attention, a resolution being introduced and referred to the committee on agriculture. This committee reported favorably and directed the Secretary of the Treasury to prepare a manual on the growth and manufacture of silk. Inquiries for information on the subject were sent out by the Secretary, Mr. Richard Rush, in 1826, and from the replies and other material received a manual was compiled, entitled "Letter from the Secretary of the Treasury." Six thousand copies were printed by order of Congress. This document contained 220 pages besides illustrations of machinery.

Such favorable action and the publication by Congress at many subsequent sessions of other documents relating to silk culture, together with the serious consideration of the subject by the congressional committee on manufacture and the committee on agriculture, enlisted general attention. Sericulture gained the public ear. Legislatures of several States passed bills for its encouragement and a most determined effort was made to place silk-growing on a paying basis. Silk conventions were held in Maryland, New Jersey, New York and Connecticut. All efforts failed, however, to make sericulture popular in this country. The American producer could not compete with the cheap labor of the Orient and Europe, and other lines of industry afforded greater remuneration. The manufacture of silk fabrics, however, has gained great success. In 1810 Rodney and Horatio Hanks erected the first mill on this continent. The manufacture of silk trimmings of various kinds was begun in 1815 at Philadelphia and ribbons in 1829 at Baltimore. Here, too, the American manufacturer was handicapped by foreign competition and it was not until a protective tariff was enforced that the industry prospered.

In order to provide money to meet the heavy expenses of the government caused by the Civil War, a high import duty was placed on all luxuries, including silk. The duty was made 30 per cent on manufactured silk on 2 March 1861 and in August of the same year was raised to 40 per cent. The tariff was again advanced on 30 June 1864 to 60 per cent, this time not only for revenue but for protection. Following this advance there was an immediate show of activity among those engaged in silk importing to consider the possibilities of manufacturing at home. Those already engaged in the manufacture of silk received a fresh stimulus. In 1872 The Silk Association of America was organized, in New York, to promote in all measures the common interest of silk-making in the United States. At the Centennial Exposition held in Philadelphia in 1876 American-made silk favorably compared with that of foreign manufacture. Much of the manufacture was conducted in the vicinity of Paterson, N. J., a mill town within easy access of the New York markets, which has grown to be the leading silk-producing city of the United States. Other advantageous centres were found in the coal fields of Pennsylvania where fuel was cheap, and this State now produces more manufactured silk than any other State in the Union. The sewing-silk and floss industry has always been confined chiefly to the New England States. In 1860 without the protection of a high tariff the total production of the industry amounted to $6,600,000. At that time importations of manufactured silk were valued at $3,300,000. These have remained nearly constant. The production figures have, however, grown in tremendous proportions and in 1914 reached a total of $254,000,000, while the number of employees rose from 5,000 to 108,000. The following tables of the imports of raw silk, waste silk and cocoons for the years 1914–18 will serve to show the amount of raw material now being consumed by the industry:

SILK IMPORTS INTO THE UNITED STATES OF AMERICA.

(Reported by the Department of Commerce, Washington, D. C. Foreign Invoice Values Only).

	1917–1918		1916–1917		1915–1916		1914–1915	
	Weight	Value	Weight	Value	Weight	Value	Weight	Value
	Pounds	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*
Raw silk........	34,846,197	$183,076,241	33,868,885	$156,085,649	33,070,902	$119,484,223	26,030,925	$80,531,785
Waste silk.......	8,583,344	7,229,176	6,420,482	4,431,164	8,657,322	4,706,689	4,970,254	2,563,658
Cocoons.........	251,447	319,349	62,056	54,995	197,078	142,743	51,495	35,114

The Manufacture of Silk.— The filament spun by the silkworm into a cocoon is so fine that several must be reeled together to produce a thread of sufficient size to handle. This is done in large factories, called filatures. Here the cocoons are placed in basins of hot water near the boiling temperature. Several filaments from as many cocoons as are required for the size of the raw-silk thread desired, are combined, twisted and reeled into skeins. When the filament from one cocoon has become exhausted it is replaced by another cocoon and the reeler adjusts the size of the thread by controlling the number of fresh and partially exhausted cocoons which are forming the thread. A single cocoon of good quality may furnish from 400 to 800 yards of reelable filament. Asiatic silks reeled by different filatures and different qualities from the same filature are designated by colorful labels called "chops." Silk that has been reeled is known as raw silk. The damaged cocoons and the parts of each cocoon which cannot be reeled are known as waste silk. Waste silks are combed and spun into spun silk or silk-schappe yarns.

Silk is imported from Europe and Asia, Japan supplying by far the greater portion. Japanese raw silk is prepared for shipment in books containing from 25 to 30 tightly-rolled skeins. These are packed in bales weighing from 125 to 140 pounds. Chinese silks are packed and shipped in a manner quite similar to Japanese silks. Italian silks are packed in large bales weighing from 200 pounds upward.

The silk used in the manufacture of silk fabrics may be divided into three general classifications, as follows: (1) Silk threads as they come from the reeler where several of the cocoon threads have been united into one. (2) Silk known as organzine in which the original threads have been twisted and several of these twisted threads have been united together. (3) Silk known as tram in which threads coming from the reeling machine have been very lightly twisted together.

When silk threads are woven as they come from the reeler, without having been dyed, the natural gum which they contain gives them enough body to make them suitable for weaving. If the threads are dyed before weaving this gum is removed in the dyeing process, and to give the threads strength and cohesion, they are twisted before dyeing. This is the work of the throwster.

Throwing.—The throwing process divides silk into two broad classifications, organzine and tram. Organzine is generally used for the warp or length of the fabric and tram for the filling or width. Silk used for organzine is usually of better quality than silk used for tram as the organzine warp is subjected to more strain in the process of manufacturing.

In throwing organzine, the silk, after soaking, is first wound upon bobbins. It is then a single thread. Each single thread is twisted, usually 16 turns per inch. Two of these twisted threads are doubled together and the resulting thread is twisted in the opposite direction, usually 14 turns per inch. The twisting operations are known as spinning, and unite the filaments into one strong even thread which is suitable for warping. In some cases more than two threads are combined. In throwing tram, or the material with which the warp is filled, the silk goes through various operations similar to organzine, but because it is to be used as a filling and not subjected to the same continued strain as the warp, it is not as tightly twisted. The twist in tram is from two and one-half to five turns per inch. If the silk is to be dyed before weaving it must be taken from the bobbins and returned to skein form. Organzine is reeled into skeins of about 20,000 yards length and tram into skeins of shorter lengths according to the number of threads into which the silk has been doubled. After reeling, short ties or laces are inserted through the skeins at several places to keep them from tangling and knotting while passing through the dyeing and subsequent operations prior to weaving. The skeins are finally inspected and put up in large bundles ready for the dyer. There are many variations to the throwing process the most important of which is the making of crepe fabrics. To prepare silk threads for crepes the twist is greatly increased and runs from 60 to 75 turns per inch. This fabric is woven before being dyed.

Dyeing.—The dyer boils the skeins in soap and water which removes the natural gum from them and leaves them soft and lustrous. They are then rinsed and passed on to the dye vat. After dyeing the skeins are dried and packed for shipment to the weaver.

Weaving.—The silk entering into a woven fabric is known in the manufacturing trade by several names. The silk threads running lengthwise are called the warp and those running crosswise which bind the warp to make the fabric are known as the filling or the shot. They are also spoken of as picks.

An ordinary warp may have from 1,000 to 20,000 ends of thread in a yard of width. The process of putting the above number of threads on a beam to be placed into the loom is commonly known as the warping process. The threads are warped in bands of from 300 to 600 at a time, each band running the entire length of the warp, which may vary from 300 to 1,200 yards. When the necessary number of bands have been placed side by side on the roller the warp is then transferred in its entirety of from 1,000 to 15,000 ends to another beam and is placed in the back of the loom. Each individual thread of this warp is passed through the harness in the loom preliminary to being manipulated into the fabric. This process is known as entering the thread. If the loom contains an old warp which has already been entered in the harness the new warp is simply twisted on thread for thread to the old warp. In preparing filling for use in the loom the filling thread, generally tram, is wound on spools. These spools are placed in what is known as a quilling machine which transfers the silk from the spools to a long, thin cylinder called a quill. A quill when covered with silk is placed into the shuttle. Formerly the quill of a feather was used for this purpose and hence the name.

The modern power-loom is a strong iron frame, at the back of which is the horizontal beam or roller from which the warp unwinds, and at the front the roller on which the web is wound as it is made. Between the two is the harness which is a series of frames with eyelets, one for every thread, or set of threads, of the warp. In plain or taffeta weaving the harness frames are in two sets of three frames each, one set of which is up while the other is down. The number can be increased to several frames, all acting independent of each other, for complicated patterns. Between the beam and the harness is the reed, through which the warp threads pass to the take-up roller in front of the loom and between the harness and the web roller, the shuttle and the batten. As the machine revolves the warp threads passing from the beam through the reed, are lifted or depressed by the harness; in the opening made by such lifting or depressing, the shuttle flies across the warp and the batten beats up the thread it leaves and a new woof is added to the fabric. The complications of the fabric reveal themselves as soon as the power is turned on and the actual web begins to appear, close, compact and delicate.

Fancy weaves and patterns necessitating different colors are often woven on what is known as a box-loom. Fabrics vary from single colors to eight colors or more in the filling. This necessitates up to eight or more different shuttles being used for the filling. The containers for these shuttles on the loom are known as boxes, hence the term box-loom. In order to form complicated designs, individual warp threads of the loom were in olden times controlled by hand, the threads being lifted or depressed thus letting the shuttle pass over or under them, forming the weave. This method is still pursued in the making of the famous Goblin tapestry and is probably the best illustration of old-time weaving. Joseph Marie Jacquard, born in Lyons, France, in 1752, is the inventor of a mechanical device to lift or depress warp threads in making fancy designs, thus doing away with hand manipulation. This is known as the Jacquard machine and when placed on a loom the loom is called a Jacquard loom.

The finished fabric after leaving the loom is inspected for weaving defects, such as loose ends, knots, etc., and is ready to receive its final manipulation before passing into the hands of the consumer. If silk used in manufacture has been dyed before being woven the fabric after leaving the loom need receive but little handling. It is smoothed out on rollers and may or may not receive a certain amount of stiffening. If the article is woven in the gray, it must now be dyed or printed before being used.

Such in brief is the manufacture of broad silks, that is dress goods, tie silks, shirtings, etc. In 1914 the census reports show a production of over 216,000,000 yards of these goods valued at over $137,000,000. Silk ribbons are made in a similar manner, except that on account of their narrowness many ribbons may be woven at one time on the same loom, according to their width. The 1914 production of ribbons was valued at over $38,000,000.

Crepe effects in the finished goods are produced by alternating a right- and left-hand highly-twisted thread in the warp and filling the fabric with a lightly-twisted tram. When the woven goods are boiled off and dyed the effect of the alternately-twisted threads will be a puckering up of the fabric and this is known as crepe-de-chine. Similar effects may be produced by running a plain warp and filling this warp with the alternately hard-twisted crepe threads. This necessitates a box-loom. But the warping for this second fabric is very much easier than the warping for the first. To avoid mistakes in handling the wrong threads, a slightly different tint, such as light blue and pink, is given to the right- and left-hand twisted threads. Hard-twisted threads in both warp and filling produce the georgette crepes.

Silk velvets and plush fabrics were formerly woven over wires so that small loops were formed on the face of the cloth which, upon being cut, made the pile. In modern manufacture two pieces are woven face to face, a sharp knife traveling between them cutting the pile threads apart. Velvets valued at $8,000,000 and plushes at $10,000,000 were produced in 1914.

Sewing silks and machine silks are tightly-twisted threads of raw silk, while floss and embroidery silks are loosely-twisted threads of raw silk. The production of these materials in 1914 was one and one-half million pounds, valued at nine and one-half million dollars.

The tables that follow indicate the growth of the silk industry in the United States:

POWER-LOOMS AND HAND-LOOMS IN THE UNITED STATES.

POWER-LOOMS.

YEAR	Broad goods	Narrow fabrics	Total
1874	1,189	888	2,077
1875	1,428	1,260	2,688
1880	3,103	2,218	5,321
1890	14,866	5,956	20,822
1900	36,825	7,432	44,257
1904	50,449	9,609	60,058
1909	64,836	10,570	75,406
1914	73,504	11,554	85,058

HAND-LOOMS.

YEAR	Broad goods	Narrow fabrics	Total
1874	779	728	1,507
1875	1,005	809	1,814
1880	1,629	1,524	3,153
1890	413	1,334	1,747
1900	164	9	173
1904	Practically none		

COMPARATIVE GROWTH OF THE SILK INDUSTRY OF THE UNITED STATES.

(The figures for 1880–1914 are United States Census returns for those years.)

PRODUCTION	1875	1880	1890	1900	1904	1909	1914
Piece goods	$5,446,329	$11,224,895	$22,955,750	$52,152,816	$66,917,762	$107,881,146	$137,719,564
Ribbons	4,815,485	6,023,100	17,081,447	18,467,1 9	21,890,604	32,744,873	38,201,293
Laces	199,652	437,000	261,750	803,104	745,489	1,350,850	1,328,933
Braids and bindings	383,100	999,685	2,771,382	1,522,565	3,493,977	4,483,248	3,073,648
Trimmings	3,961,114	8,306,520	8,544,566	2,295,010	4,124,651	4,674,975	3,341,750
Sewing and twist	6,420,833	6,783,855	7,068,213	10,246,190	10,146,071	10,521,074	9,681,613
Velvets and plushes			3,141,026	4,959,971	4,502,021	6,872,758	18,705,864
Tapestries and upholstery stuff			3,712,332	1,009,835	1,559,982	382,820	840,126
Embroideries				57,625	112,362	485,322	33,500
Other products		744,668	2,542,625	1,211,325	5,227,800	4,495,675	12,083,373
Total	$21,226,513	$34,519,723	$69,154,599	$92,725,620	$118,720,719	$173,892,741	$225,009,664
No. of throwing spindles	168,843	262,312	718,360	1,045,304	1,394,020	1,761,758	2,159,271
Spun silk consumed (pounds)	150,000	*	*	1,550,291	1,951,201	2,112,972	3,209,309
Raw silk consumed (pounds)	1,275,872	2,690,482	6,376,881	9,760,770	11,572,783	17,472,204	22,374,700
Yarn other than silk (pounds)	*	*	5,624,960	7,116,728	9,730,769	15,786,354	23,258,455
Consumed in sewing and twist (pounds)	544,470	791,525	1,119,825	1,465,575			
No. of operatives	18,017	31,337	49,382	65,416	79,601	99,037	108,170
Wages paid	$6,392,256	$9,146,705	$17,762,441	$20,982,194	$26,767,943	$38,570,085	$47,108,469
Capital invested	$17,913,858	$19,125,300	$51,007,537	$81,082,201	$109,556,621	$152,158,002	$210,071,679

* Indicates "not reported."

3. **Foreign Silk Industry.**— In the opening decades of the 9th century the chief silk-producing regions were Syria, Persia, India, Italy and France. With the opening of trade with China in the middle of the century great quantities of silk began to arrive in the markets of the world from Shanghai and later from Canton. Japan came into the field as an exporter about 1857 and was soon a serious competitor because of the high quality of its product. To-day China and Japan export only their excess growth of silk, as the great bulk of their native silks are woven and sold in the home market. The same is to a large degree true of other silk-producing countries and regions of Asia. Within the last half-century the world's silk production (calculating only exports from the East, the total production there being unknown) has more than doubled. America is at present the greatest consumer of raw silk, followed at considerable distance by France. Lyons is the centre of the silk trade of France, producing chiefly dress goods. The chief centres of the ribbon trade are Saint Etienne and Saint Chamond. In addition to these there are large silk mills at Paris, Nimes, Calais, Avignon, Roubaix and Tours. France consumes in normal years about 10,000,000 pounds of raw silk and produces less than one-fifth of this amount. Germany consumes about 7,000,000 pounds annually. The industry there is centred at Crefeld. Velvet is the principal textile product of the German silk industry, occupying over half the entire number of looms. Other silk manufactures are located at Barmen, Elberfeld and Mühlheim. Switzerland has an important silk trade, consuming about 4,000,000 pounds annually in normal years. Zurich produces satins, serges and other broad goods. Basel is an important centre of the silk ribbon trade. Silk manufacture received a great impetus in Russia by the enactment of a prohibitive tariff about 1890. The consumption of raw material in normal years is approximately 3,250,000 pounds. The Caucasus supplies about 1,000,000 pounds of raw silk to the Russian mills, Moscow is the chief silk-manufacturing centre. Italy, once first in the trade of Europe has fallen to about sixth place as a manufacturing country, using only 2,000,000 pounds annually. As a producer of raw silk of fine quality it still holds a high place, producing about 10,000,000 pounds in normal years. Como, Genoa and Venice are still the chief seats of silk manufactures in Italy. Austria has important silk manufactures, mostly centred in Vienna; it consumes about 1,500,000 pounds of raw silk annually and produces about 500,000 pounds of this amount. Hungary produces nearly 1,000,000 pounds annually, most of which was formerly exported to the mills of Austria. England's silk manufactures have declined since 1860. Manchester, Macclesfield, Middleton, London and Nottingham are the chief centres of the industry there, which consumes annually about 1,700,000 pounds of raw silk. The following table gives the production of raw silk in 1913-19:

RAW SILK PRODUCTION, INCLUDING TUSSAH SILK.
Seasons 1913–1914 to 1918–1919.

PLACE	1918–1919	1917–1918	1916–1917	1915–1916	1914–1915	1913–1914
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Europe	6,967,000	7,154,000	8,977,000	7,087,000	10,671,000	9,337,000
Viz:						
Italy	5,942,000	6,217,000	7,963,000	6,349,000	8,951,000	7,804,000
France	529,000	452,000	485,000	286,000	893,000	772,000
Austria	331,000	331,000	331,000	331,000	666,000	580,000
Spain	165,000	154,000	198,000	121,000	161,000	181,000
Levant	‡2,293,000	2,293,000	2,293,000	2,293,000	3,935,000	5,004,000
Asia (total quantity exported*)	45,719,000	48,026,000	46,725,000	41,152,000	32,240,000	42,874,000
Viz:						
China, Shanghai	†9,230,000	8,563,000	9,240,000	9,836,000	6,604,000	9,975,000
China, Canton	3,750,000	5,170,000	5,567,000	4,083,000	4,168,000	5,995,000
Japan, Yokohama	32,485,000	34,050,000	31,724,000	27,013,000	21,358,000	26,650,000
India (estimated)	254,000	243,000	194,000	220,000	110,000	254,000
Total	54,979,000	57,473,000	57,995,000	50,534,000	46,846,000	57,215,000
Tussah	1,540,000	1,534,000	1,805,000	2,556,000	2,108,000	2,757,000
Grand total	56,519,000	59,007,000	59,800,000	53,090,000	48,954,000	59,972,000

* The production of raw silk in China is an unknown quantity. † Excludes Tussah silk. ‡ In the absence of statistics from Austria and the Levant, 1915 production is used as an estimate.

The domestic consumption of raw silk in Japan is estimated to be 25 per cent of the production. The remaining 75 per cent which is exported, being 32,485,000 pounds during the season 1918–1919, would indicate a crop of approximately 43,314,000 pounds.

The domestic consumption of raw silk (including Tussah) in China is estimated to be 55 per cent of the production. The exports from Canton and Shanghai during the season 1918–1919 were 14,520,000 pounds, which would indicate a crop of approximately 32,267,000 pounds.

Compiled by the Statistical Bureau of The Silk Association of America.

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RAMSAY PEUGNET,
Secretary of the Silk Association of America.

SILK-COTTON TREES, any one of the trees belonging to several tropical genera of the family *Bombacaceæ*, as *Bombax, Ceiba, Eriodendron, Ochroma* and *Pachira*. They are usually large trees, the greater number native to Central and South America, with handsome mallow-like flowers, light, soft wood and bark containing bast fibres used for cordage. Those species most entitled to the name are *Bombax malabaricum* of the East Indies, and *Ceiba pentandra*, of both the Oriental and American tropics. The latter, the silk-cotton tree of the West Indies, is one of the most abundant and largest trees of the Antillean forests, and is either low-branched or tall, with naked trunk and massive crown lifted high above the other trees. When young its trunk and branches are covered with sharp spines, which afterward disappear. The bark is hard, clean and white, surrounding a pulpy interior. The trunk is sometimes 100 feet high, and in well-grown specimens is without branches for the lower part; but as the tree ages the trunk enlarges near the ground, being sometimes 12 feet in diameter and great buttresses, tall and thin, spring from it on all sides and run out in an undulating fashion, for perhaps more than 100 feet along the surface of the ground, before finally penetrating the soil and anchoring the tree. These braces are invaluable for bracing the tree against heavy winds. The leaves are glossy, dark green and deciduous. The yellow flowers appear just before the leaves and are followed by great pods whose valves burst open when mature, causing the tree to seem smothered in glistening white thistle down. This is because the seeds are wholly invested in delicate cotton-like fibres, and being very light are carried off by the wind for long distances. Unfortunately, although closely allied to the cotton plant (*Gossypium*) these fibres are too short to be woven into textiles, but they are employed for stuffing cushions and other upholstery, and are an important article of trade, under the name «Kapok,» the principal source of supply being Java. The seeds are eaten in some Pacific islands. *Ochroma lagopus* is also called down-tree, or cork-wood, on account of its light porous wood.

SILK-WEED. See Asclepias.

SILKWORM-GUT, a substance prepared from the silky secretions of the caterpillars of the ordinary silkworm taken from the insects' body, and constituting the lustrous and strong line so well known to anglers under the name of «gut.» It is especially sought after because it is invisible in the water. In securing the secretion the worm is placed in vinegar and the incipient cocoon is then taken from it, soaked in water, dried and bleached to a pure white by passing through fumes of sulphur.

SILKWORMS, entomologically, any caterpillar which spins a cocoon of silky fibre; popularly, the various species which yield a fibre used commercially. All are caterpillars of moths and feed upon foliage of various trees and shrubs. Among the less important species the following are probably best known: The Japanese oak-feeding silk-moth (*Bombyx yamamai*) is noted for its green-tinted silk, which is used in Japan and China for embroidery; a close relative (*B. peryni*), also an oak-feeding insect, is a native of northern China, where its large grayish-brown cocoons are used to a considerable extent for threads and various fabrics. The Chinese also use for the manufacture of a soft fabric the gray silk of an allied species (*B. cynthia*), which feeds on the tree of heaven (*Ailanthus glandulosa*). Since the thread cannot be reeled the silk is obtained by carding methods. So far as known these species have not been extensively employed commercially except in the Orient, though they have been used tentatively in France and other silk-manufacturing countries. The tussur or tusseh moth (*Antheræa paphia*) spins a hard grayish-white cocoon from which the natives of India, where the species is indigenous, manufacture tussur silk. The Bengalese use the pure white silk of the boro poloo (*Bombyx textor*) and the yellow silk of the dasee-worm (*B. fortunatus*) for making a silk cloth which rarely reaches the world's markets because of its inferior quality. Several North and South American species yield silk which has not become commercially important. The native silkworms of the United States, Mexico and Central America have never been properly commercially exploited or cultivated; but several varieties possess qualities which would seem to promise success to him who would raise them scientifically. They are hardy and spin large quantities of excellent, strong silk. They feed upon a much larger variety of food than do the silkworms commercially known to the Old World. This comprises the leaves of the oak, apple, maple, hickory, willow, sycamore and many other trees. One of the most promising of these American silkworms (*Telea polyphemus*) is a large buff-colored moth. The cocoon threads are bound together with a hard gluey matter which has to be softened before unwinding can be done. The Tropæluna, the larva of which feeds on the leaves of several forest trees, is somewhat similar to the foregoing and both resemble the Yamanai. Cultivation and proper selection would undoubtedly improve them commercially. The amount of silk they produce is far greater and stronger than is produced by the Chinese silkworm, but the thread cannot be so easily reeled.

The most important and most widely disseminated species of silkworm is *Bombyx mori*, which belongs to the family Bombycidæ, a native either of northern China or of Bengal. It seems to have been domesticated at a very early date, which is placed by Chinese authorities at 2600 B.C., when the wife of Emperor Hoang-ti began feeding the caterpillars In 552 two monks brought eggs to Constantinople, superintended experiments in cultivating the worms and turned the industry over to the Emperor Justinian, by whom it was monopolized. Neighboring peoples soon took it up, however; and now many countries, especially those of the Mediterranean region, Persia, India and Arabia, raise silk in commercial quantities.

The commercial silkworm is the larva of a large moth with a short thick body, stout legs and broad white wings crossed by several black lines or by a pale bar upon the anterior pair. In early summer the females lay from 200 to 500 bluish eggs, about as large as a pin's head, singly upon any convenient surface, gluing them there by a mucilaginous secretion, silky when dry. These do not hatch until the following spring. Then the larvæ, about one-quarter of an inch long and yellowish-gray or brownish, begin to feed, and soon consume about their own weight of foliage daily and increase rapidly in size. When about 10 days old they become lethargic and stop eating until after they have cast their skins. In this operation the old skin bursts near the front and the caterpillar squirms itself out, leaving the old skin attached to the branch or leaf upon which it was stationed. The worms rapidly increase in size immediately after the molt, then steadily diminish as the time for the next molt approaches. The process is performed four times before the caterpillar spins its cocoon, which it does when about six weeks old. At this time it is about three inches long and half an inch in diameter, has 12 visible body segments, three pairs of true legs and five pairs of pro-legs. It now ceases to feed, empties its alimentary tract, and seems to shrink in size. The spinning then begins by the insect making first an outer network known as the «floss,» and then winding the silk in a continuous thread around its body which continues to decrease in size. The completed cocoon is considerably shorter than the caterpillar itself, being only about one and one-half inches long. The operation of spinning occupies about five days, during which time the insect usually produces from 2,000 to 3,000 feet of silk, which, when microscopically examined, is seen to consist of two blended strands. These are produced by special glands (sericteria) which extend nearly the whole length of the body and terminate in apertures (spinnerets) situated in the mouth. In from 15 to 20 days after the chrysalis has been formed the adult insect emerges, lays its eggs and dies. It has been estimated that there are about 20,000 to 40,000 eggs, popularly known as «seed» in an ounce. About one ounce of eggs will yield 100 pounds of cocoons or nine pounds of raw silk. From 15 to 20 pounds of good mulberry leaves should yield one pound of cocoons; and a well-grown mulberry tree should yield about 100 pounds of leaves. The amount of space allowed for the caterpillars produced from an ounce of eggs varies from one square yard, immediately after hatching, to about 64 square yards when spinning time arrives — each change being double the previous space: 2, 4, 8, 16 and 32.

The food of the caterpillars is preferably the foliage of the white mulberry tree (*Morus alba*); but several other species are employed, notably the Japanese mulberry (*M. japonica*), the alpine mulberry (*M. alpina*), and *M. multicaulis* and *M. moretti*. The osage orange (q.v.) is occasionally used as a substitute, but is said to produce an inferior grade of silk. The black mulberry (*M. nigra*) is objectionable because it is slow in growth. The caterpillars also thrive upon the leaves of lettuce and some other plants.

In the cultivation of the silkworm the first requisite is an ample supply of foliage. This is usually obtained by growing the mulberry trees far enough apart to give each ample room to develop its branches in all directions, the distance varying from 15 to 40 feet depending upon the variety, method of training, etc. Frequently the trees are treated much the same as in pollarding (q.v.), except that the branches are cut while small. The eggs having been kept over winter at a temperature of less than 50° F. in a dry circulating atmosphere, are placed in a room or an incubator in which the temperature is raised gradually to about 73°. In about 10 days the larvæ emerge and are covered with sheets of perforated paper sprinkled with chopped mulberry leaves, which should be renewed about nine times during the first 24 hours, each time by placing a fresh paper above the soiled one, which should be burned. Paper with larger perforations is necessary as the worms grow. As they approach maturity their appetities become voracious. When ready to spin they should be supplied with brush, straw or other material upon which to form their cocoons and the temperature at this time should be kept about 75° and the humidity close to 65°. At all times scrupulous cleanliness is essential, as also is abundant fresh air. When spinning is completed, no sound is heard inside the cocoon. The cocoons are then sorted according to quality, size and color into nine grades for manufacture, a separate lot being selected for breeding. The sexes are readily recognized, the males being smaller and their cocoons having more pointed ends than those of the females. After grading they are heated to destroy the insects within, whose emergence, if left alive, would break the thread many times. The manufacturing process is then begun.

Where a uniform and favorable temperature is not maintained, where humidity and purity of the air are impaired, and still more, where there is deviation from the strictest cleanliness, silk growers have often experienced serious losses of their caterpillars at all stages of their growth. Purifying the breeding and feeding quarters after each «crop,» and again before the introduction of a new one, are essential. The walls are whitewashed, the trays sterilized in various ways, and the apartments fumigated with burning sulphur. No detail that will ensure cleanliness throughout the feeding period must be neglected, else the worms may suffer from the diseases which follow in the wake of neglect. Four of these, called in France pébrine, muscardine, gattine and flacherie, are due to infectious organisms. For a fifth disease, grasserie, no ascribable cause has been discovered. Pébrine devastated France to such an extent that by 1847 eggs were all imported from Italy. By 1865 the only safe source of egg-supply was Japan. Pasteur showed that rational methods of cleanliness in the breeding and feeding were the only remedy; the result is that France exports over 300,000 ounces of eggs annually. See SILK AND SILK INDUSTRY.

Bibliography.— Kelly, 'Culture of Mulberry Silkworm,' Bulletin 39, Division of Entomology, United States Department of Agriculture (Washington 1903); Oliver, G. W., 'Mulberry and Other Silkworm Food Plants' (Washington 1907); Verson and Quajat, 'Il filugello e l'arte sericola' (Padua 1896); Villon, 'La Soie' (Paris 1890).

SILL, Edward Rowland, American scholar and poet: b. Windsor, Conn., 29 April 1841; d. Cleveland Falls, Ohio, 27 Feb. 1887. He was graduated from Yale in 1861, entered business in California, but returned to the East, and studied at the Harvard Divinity School. His views toward the ministry, however, he soon abandoned; and he became literary critic on the staff of the New York *Evening Mail.* Thence he went to Ohio, where he did some teaching, and to California, where he was made principal of the Oakland high school (1871) and professor of English literature in the University of California. In 1883 he returned to Ohio to devote himself wholly to literary work. Sill did not write readily, nor willingly collect what he had at intervals printed in magazines, particularly the *Atlantic*. He won, nevertheless, a recognition which, if not general, is ample, and a just tribute to real gifts. He wrote with a certain terse austerity not, as has been pointed out, unlike Emerson. Indeed, he was, in thought and manner, a later transcendentalist. One of his poems, 'The Fool's Prayer,' is the property of every anthology. The posthumous selection, 'Poems' (1888), contains his best. 'Hermione, and Other Poems' appeared in 1899, and in 1900 'The Prose of Edward Rowland Sill, with an Introduction Comprising Some Familiar Letters.' Consult Parker, W. B., (ed.) 'Poetical Works of Edward Rowland Sill' (1906); id., 'Edward Rowland Sill: His Life and Work' (Boston 1915).

SILL, Joshua Woodrow, American general: b. Chilicothe, Ohio, 6 Dec. 1831; d. Murfreesboro, Tenn., 31 Dec. 1862. He was graduated from the United States Military Academy in 1853, and was soon called to the academy as assistant professor of ethics, geography and history. He resigned from the army in 1861 and became professer of civil engineering and mathematics in the Brooklyn Polytechnic Institute. He commanded a division of the army of Ohio in 1862, and was killed while leading his brigade at the battle of Murfreesboro.

SILL. See Dike.

SILLIMAN, sĭl'ĭ-man, **Benjamin,** American scientist: b. North Stratford (now Trumbull), Conn., 8 Aug. 1779; d. New Haven, Conn., 24 Nov. 1864. He was graduated from Yale in 1796, studied law and was admitted to the bar in 1802, but accepted the chair of chemistry and natural history at Yale in 1802. He went abroad in 1805 to continue his studies, and while in Edinburgh became interested in geology. On his return home he made a geological survey of a part of Connecticut, the first survey of the kind made in the United States, and in 1807 published an account of the celebrated Weston meteorite of 14 Dec. 1807. In 1811 he began a series of experiments with the compound blowpipe, obtained for the first time in the United States the metals sodium and potassium, and discovered in 1822 the fusion of the carbons in the voltaic arc. He founded the *American Journal of Science* in 1818, acting as its sole editor until 1838, and as senior editor until 1846, opened the Lowell Institute in Boston with a series of lectures on geology in 1838, and in 1840 was elected president of the American Association of Geologists. He resigned his chair at Yale in 1853 and was made professor emeritus, but continued to lecture until 1855 when he retired. He was named by Congress for one of the original members of the National Academy of Sciences in 1863. His publications include 'Journal of Travels in England' (1810); 'A Tour to Quebec' (1819); 'Elements of Chemistry' (1829); 'Consistency of Discoveries of Modern Geology with the Sacred History of the Creation and the Deluge' (1837); 'Narration of a visit to Europe in 1851' (1854), etc. Consult Fisher, 'Life of Benjamin Silliman' (2 vols., New York 1866) and Gilman, D. C., 'Leading American Men of Science' (New York 1910).

SILLIMAN, Benjamin, American chemist, son of the preceding: b. New Haven, Conn., 4 Dec. 1816; d. there, 14 Jan. 1885. He was graduated from Yale in 1837 and in 1838 became instructor in chemistry, mineralogy and geology at Yale, was appointed professor of applied chemistry in 1846 and in 1854 succeeded his father in the chair of chemistry, a position he occupied until his death. He was one of the founders in 1847 of the Yale Scientific School and was professor of medical chemistry and toxicology in the University of Louisville, Ky., in 1849–54. He was in charge of the departments of chemistry, mineralogy and geology at the World's Fair in New York in 1853, was elected one of the original members of the National Academy of Sciences in 1863, and in 1869 became one of the State chemists of Connecticut. He published 'First Principles of Chemistry' (1846; 2d ed., 1856); 'Principles of Physics' (1854; rev. ed., 1868); 'American Contributions to Chemistry' (1875), etc. Consult Wright, A. W. (in National Academy of Sciences, 'Biographical Memoirs,' Vol. VII, Washington 1911).

SILLIMANITE, a mineral occurring in long slender crystals and fibrous masses, and composed of silicate of aluminium (silica 36.9, alumina 63.1 = 100). Its crystals belong to the orthorhombic system; its hardness varies from 6 to 7 and its specific gravity from 3.2 to 3.3. The color is various shades of brown, or gray, or greenish. The streak is uncolored and the mineral varies from transparent to translucent. It occurs in gneiss, mica schist and other metamorphic rocks in Massachusetts, Connecticut, New York, Pennsylvania, Delaware, North Carolina, etc. The name was given in honor of Professor Silliman of New Haven.

SILO, a building for the preservation of green fodder, usually cut fine before storing, and known as silage (q.v.). Originally silos were merely pits dug in the ground and filled with green fodder which was closely covered to exclude the air. From 1875 the silo built above ground of wood, brick, concrete and other permanent materials has come into use and is steadily increasing in numbers. Silos are built on a cement foundation, and most frequently are of wood, which is equally efficient in preserving silage and while of less permanent character is selected because its initial cost is less. The buildings are air tight, usually of circular shape (the rectangular type permitting the silage to spoil in the corners), are roofed and usually about 30 feet in depth. The greater depth insures the silage packing solidly, excluding the air. The walls are vertical and finished smoothly inside in order that the silage may settle evenly. Openings are provided one above another on the side most convenient for feeding so that the contents of the silo are readily reached, but none is required in the top space because of the settling of the silage. Concrete makes an excellent and permanent building, and brick and stone, lined with cement are likewise desirable.

SILOAM SPRINGS, Ark., city in Benton County, 40 miles southwest of Bentonville, on the Kansas City Southern and other railroads.

It is located in a prosperous agricultural region, and has flouring mills, corn and feed mills, ice and storage plant and a large cider and vinegar plant. It has two banks with deposits in excess of $1,000,000. The value of the city's taxable property is $800,000. It is the seat of Siloam College and a high school. There are seven churches, a city hospital and a municipal building. Pop. 4,000.

SILOAM, sĭ-lō'am, or **SILOAH**, sĭ-lō'a̤, a pool or tank in Jerusalem, fed by the waters of Gihon and forming part of the ancient water-supply system of the city: a tunnel of 1,700 feet leads to the pool from the «fountain of the Virgin.» In 1880 some boys playing in the pool crawled into this ancient tunnel, and one of them noticed a tablet bearing an inscription. That inscription, as deciphered by scholars in 1881, tells of errors of measurement committed by the miners and how they were corrected. In places the inscription is undecipherable, but, line for line, it is rendered thus:

1. Lo the tunnel. Now this is the history of the tunnel. While yet the miners were plying
2. The pick, each toward his fellow and while there were yet three cubits to be cut, there was heard the voice of a man
3. Calling to his fellow, for there was a *misdirection** in the rock on the right hand . . . and on the day
4. Of tunneling through, the cutters smote pick against pick and there flowed
5. The water from the channel to the pool, 1,200 cubits, and
6. Cubits was the height of the rock above the excavator's heads.

* Conjectural.

Hezekiah is believed to have built this water-supply system. Scholars are not in agreement as to the date of the inscription, some holding that it dates from a period long subsequent to that of Hezekiah even as late as 200 B.C. Consult Socin, A., 'Die Siloahinschrift' (Freiburg 1899) and Tobler, 'Die Siloahquelle und der Oelberg' (Saint-Gall 1852).

SILOXICON. See ELECTROCHEMICAL INDUSTRIES.

SILURES, sĭl'ū-rēz, the name of an ancient British tribe which inhabited the district included in the modern counties of Hereford, Radnor, Brecknock, Monmouth and Glamorgan. They were of the earlier Celtic stock, and were among the most warlike of the British tribes. They were subdued by the Romans about 78 A.D. Cærwent was founded by them, but was later Romanized.

SILURIAN, a term applied in 1835 by Sir Roderick Murchison, director-general of the Geological Survey of Great Britain, to those rocks of South Wales (the country of the old Silures), which were formerly included as «grauwacke» in the Transition System of rocks. The term is also applied to the period during which this system of rocks was laid down, now recognized as the third period of the Paleozoic Era. In the typical region the rocks are divided as follows:

		Approx. average thickness (feet)
Upper Silurian	6. Ludlow Group.............	1,900
	5. Wenlock Group............	1,600
	4. Llandovery Group.........	3,000
Lower Silurian	3. Bala and Cardoc Group....	6,000
	2. Llandeilo Group...........	3,000
	1. Arenig Group..............	4,000
		19,500

While Murchison was studying these strata in South Wales, the renowned Adam Sedgwick studied the rocks of North Wales, making out their true succession, and naming them «Cambrian,» from the ancient name of the district, Cambria. These were also divided into an upper and lower division, and as the study continued year after year, higher and higher strata were added to the top of the Cambrian series. Likewise, in the study of the Silurian strata, Murchison included lower and lower strata, and thus the two systems overlapped. It finally appeared that Murchison's Lower Silurian and Sedgwick's Upper Cambrian were equivalents, and this gave rise to a long controversy as to the use of the proper term. This controversy outlived the two principals, and has only recently been settled by the adoption of Lapworth's name «Ordovician» for the middle series. Thus the term Silurian is restricted today by most geologists to the Upper Silurian of Murchison.

In North America the following subdivisions are recognized:

Upper Silurian or Cayugan group.
  Manlius limestones,
  Bertie limestones,
  Salina formation.

Middle Silurian or Niagaran group.
  Guelph formation,
  Lockport dolomites,
  Rochester shales,
  Clinton formation.

Lower Silurian or Oswegan group.
  Medina sandstone,
  Oneida conglomerate or sandstone.

Ordovician precedes and Devonian follows the Silurian. The formations are typically exposed in the State of New York, where the lower members are conglomerates and sandstones, the middle shales, limestones and dolomites and the upper shales and shaly limestones. The formations are best exposed along the Niagara River, where most of them are visible. The aggregate thickness here is 2,100 feet, though the upper member (Manlius) is partially absent. Eastward in New York some strata thin out, while others are absent through erosion. The Silurian strata are well developed in Michigan, Ohio, Indiana, Illinois, Wisconsin, Kentucky and Tennessee, though generally much thinner than in New York. They are also more calcareous. In the Appalachians the Silurian strata are frequently represented by shore deposits. Throughout most of their extent, the strata are richly fossiliferous, containing sponges, graptolites, corals, brachiopods, mollusks and triliobites. Fish are also found, but are rare. Toward the end of Silurian time the remarkable crustaceans known as eurypterids (q.v.) became abundant and constituted a marked feature of the life.

As a result of the Taconic Revolution, at the close of the Ordovician (q.v.), the seas were much restricted at the beginning of the Silurian, in the United States. During the Clinton coastal swamp conditions prevailed over much of Eastern United States, and great sedimentary beds of iron ore were laid down, from New York to Alabama. These are very extensively mined in New York and at Birmingham, Ala. During mid-Silurian time the interior continental sea was very greatly enlarged, and was united with the waters covering parts of Europe, probably by a channel across the

Arctic region. This permitted migration from European seas into central North America, so that we find many Silurian fossils of this region also common in the European localities (Gotland, etc.). The widespread Niagara limestone was formed in this sea. Migration along an Atlantic coast line between Western Europe and eastern North America also took place in Silurian time, as shown by the similar faunal characteristics of the Silurian beds of Maine and the island of Anticosti to those of southern England.

In late Silurian time the waters of the interior sea were entirely enclosed and life became extinct, the sea water itself becoming highly concentrated, probably under desert conditions. In this enclosed basin the salt-bearing strata of the Salina formation were laid down, and these now constitute a great commercial source of salt.

Widespread marine formations in Europe show that that continent was also widely covered by shallow seas during the period. A central land mass probably separated a northern and a southern sea. See GEOLOGY; SALINA FORMATION; SALT.

SILURIDÆ. See CATFISH.

SILURIST, The. See VAUGHAN, HENRY.

SILVANUS, sĭl-vā'nŭs. See MARS.

SILVA, sĕl'va, **José Asunción,** Colombian poet: b. 1860; d. 1896. Though apparently very much of a pessimist, his poems abound in evidence that his pessimism was to a great extent accidental and unnatural to the poet. He displays a deep love of nature, of the beauty of the musical sound of words, and, at times, of the mere joy of living. His nature was deeply poetical, and he suffered from an over-sensitiveness which helped to embitter his life. This bitterness, which constantly creeps out, accentuates and gives peculiar vivacity to his pessimism. Silva, who was of an old, wealthy and aristocratic Colombian family, found himself reduced, through the fortunes of revolution, to poverty. As his father had already died, he was forced to support the family. He struggled on against adverse fortune, writing because he needs must write to give expression to his burning soul, but unable to find a publisher for his work, and too poor to issue it at his own expense. At the same time he waged an unsuccessful fight for the recovery of his father's property. Finally he found a publisher in France, and for a time hope ran high, but the vessel bearing the manuscript to Europe was lost at sea. In his later days he became a literary figure in Latin America through his contributions to the press; but it was not until after his death that his poems were issued in book-form. Some of his poems like the 'Crepúsculo,' 'Ante la Estatua' (of Bolivar), 'El Dia de Difuntos' and 'Los Nocturnos' are known wherever the Spanish language is spoken. There are few Latin American writers whose work is so hard to translate into a foreign tongue as that of Silva. He has a strange power over the melody of words and a deep and fanciful imagination of a distinctly poetical caste. About his work there is a haunting sense of melody that recalls the best of Poe's poetry; though Silva never displays the weird fancy of the latter's tales. He was original in many ways; his lines are often as musical as the best in the Spanish tongue. He invented new rhymes, reformed and reshaped old ones, introduced still others from foreign languages and successfully adapted them to the Spanish tongue. His innovations and his mannerisms were widely imitated and had their influence upon the younger generation of Latin-American poets, of which the leaders were Rubén Dario (q.v.) and José Santos Chocano. Owing, however, to the peculiarity of his style and his unnatural pessimism, the poetry produced by his imitators has been, for the most part, of rather indifferent quality. But his influence has been decidedly beneficial in leading Latin-American poets to attempt to fit the music of words to the beauty and harmony of poetic thought, and to seek more freedom and flexibility in the use of poetic forms. Consult Blanco Fombona, José, 'Letras y Letrados de Hispano America'; Coester, A., 'Literary History of Spanish America' (New York 1917); La Habana, 'Arpas Cubanas' (1904); Mityans, A., 'Estudio sabre el movimiento cientifico y literario de Cuba' (Habana 1890).

SILVAS AMERICANAS. Although some critics might deny that Andrés Bello is the greatest Spanish-American poet, certainly no one will deny that his 'Silva to Agriculture in the Torrid Zone' is the greatest poem that Spanish America has yet produced. The other of the two silvas, 'Allocution to Poetry,' is fragmentary, one part containing an address to poetry, the other to Colombia. Bello probably despaired of completing this poem on the grandiose scale he had planned, and in 1826, three years after the appearance of the fragments, he published the second silva to agriculture, more restricted in scope and containing lines taken from the first. A silva is a metrical composition of lines of seven and eleven syllables, some in free version, others rhyming without fixed rule. Bello's 'Silvas' are the most exquisite imitations in Spanish of Virgil's 'Georgics'; the author's style is noble and ethical and he is a finished master of poetic diction. With lofty inspiration Bello urges his compatriots to give up political strife and greed for wealth, and seek peace and happiness in the cultivation of the beautiful exotic vegetation of young America. M. A. Caro's 'Poesías de Andrés Bello' contains a very good critical introduction. Extracts can be found in Hill's and Morley's 'Modern Spanish Lyrics,' which contains an excellent article on Bello.

SAMUEL M. WAXMAN.

SILVELA, sēl-vā'la, **Francisco,** Spanish statesman and Conservative leader: b. Madrid, 1843; d. 29 May 1905. He studied law and entering politics became a member of the Cortes in 1869. Ten years later he held the portfolio of Minister of the Interior in the Campos ministry and that of Minister of Justice in 1883–84. In 1899 he became Prime Minister, which office he held until October 1900, when he was obliged to resign. In 1902 he was again called on to form a cabinet and retired the following year. He was for many years the foremost leader of the Spanish Conservatives. He was elected to the Royal Spanish Academy and to the academies of fine arts and of history, moral and political sciences.

SILVER, one of the best known metals, has been in use for a long period, probably since before the beginning of history. It is widely distributed and can be easily extracted from some of its ores.

Physical Properties.— Silver is very malleable and ductile, being surpassed only by gold in these qualities. It is harder than gold, but softer than copper. It can be rolled into sheets 1/1000 inch thick, and silver foil is made thin enough to transmit light. Silver leads all the metals as a conductor of electricity and is second only to gold as a conductor of heat. Its specific gravity is about 10.46; its melting point 960° C., and it can be distilled as a greenish vapor in the electric arc, its boiling point being over 2,000° C. When molten it can absorb oxygen to 22 times its own volume; this is given off when the metal cools, causing the phenomenon known as «spitting.» This occurs only when the silver is pure and a very small per cent of copper, zinc or bismuth prevents it, as does a layer of some substance having no oxydizing action of the molten metal, like powder charcoal or common salt.

Chemical Properties.— Silver alloys readily with mercury, lead, zinc, gold and copper. The alloy with mercury, known as silver amalgam, is formed in various processes for extracting silver from ores, mercury being able to extract metallic silver from its compounds with chlorine, bromine and iodine. If such an amalgam be heated above the boiling point of mercury, the mercury volatilizes, leaving the silver. Lead has the power of extracting silver from its compounds with copper, sulphur, arsenic, antimony and silver salts by the formation of lead-silver alloys, a property of great metallurgical importance in the treatment of silver ores. Alloys of silver and copper are formed in smelting argentiferous copper ores, the silver and copper being subsequently separated by refining. As pure silver is soft and abrades easily, all silver used in coinage or for making silverware is alloyed with copper to give hardness. The United States silver coinage contains 900 parts silver and 100 parts copper; British coinage contains 925 parts silver and 75 parts copper.

Silver is not affected by either dry or moist air at ordinary temperatures, neither is it affected by caustic alkalies or vegetable acids. It is dissolved by hot, concentrated sulphuric acid and easily dissolved by nitric acid. Sulphuretted hydrogen forms black silver sulphide and to this is due the familiar tarnishing or blackening of silverware, either by articles of food containing sulphur, as eggs, or by the minute percentage of sulphuretted hydrogen contained in city air or the air of rooms when coal gas is used as an illuminant. So-called oxydized silver is silver with a superficial black coating obtained by immersing in potassium sulphide or platinum chloride. Frosted silver has a rough dead surface produced by heating with nitre.

Silver forms three oxides, but none is of any particular importance. Silver chloride ($AgCl$), readily formed as a curdy white precipitate on adding a soluble chloride to an acid solution of a silver salt, is insoluble in acids but readily soluble in ammonia, in potassium cyanide and in sodium hyposulphite and less soluble in a saturated solution of any one of several chlorides. It is also formed in treating silver ores with common salt. Silver nitrate ($AgNO_3$), formed by dissolving silver in nitric acid, is a white crystalline salt readily soluble in water. Fused and cast into sticks, it is known as lunar caustic and is used in surgery. In solution it is used as a chemical reagent. Silver bromide ($AgBr$) and silver iodide (AgI) resemble the chloride and like it are used in photography. Silver sulphate (Ag_2So_4), a slightly yellow crystalline salt, is readily soluble in hot water but less in cold. Silver sulphide, black, is formed by adding a soluble sulphide to a silver salt.

Silver Ores.— The minerals which, singly or in combination, are mined as silver ores may be divided into three classes: Silver minerals proper, lead silver minerals and lead copper minerals. In the first class come native silver; cerargyrite, argentite, pyrargyite, prousite. Native silver occurs in irregular bunches or thread-like or branching masses, either by itself or associated with other silver ores or with native copper. It adds to the value of an ore body, but rarely occurs in sufficient quantity to be worked for itself. The once famous Silver Islet mine on the north shore of Lake Superior produced splendid specimens of native silver. Cerargyrite, horn silver, is the chloride and contains 75.3 per cent of silver when pure. It occurs in horn-like masses, of a grayish color which turns black on exposure to light, is so soft that it can be easily cut with a knife and is of common occurrence in what is known as the oxydized zone of mines worked for silver. Rich masses have been taken from the mines at Leadville, Colo., and there are many other mines producing this ore in the West. Larger quantities have come from some Mexican mines, particularly those in Guanajuato. Embolite, a chlorobromide, $Ag(ClBr)$, bromyrite, the bromide, and iodyrite, the iodide, resemble horn silver closely and are found associated with it. Argentite, or silver-glance, silver sulphide (Ag_2S) is the commonest of the silver minerals proper. It is black, has a metallic lustre and cuts easily, though harder than horn-silver. When pure it contains 87.1 per cent of silver. Silver sulphide combines readily with the sulphides of antimony or arsenic, forming double salts. Of these pyrargyrite ($3Ag_2S.Sb_2S_3$) or ruby silver ore contains 60 per cent of silver, proustite ($3Ag_2S.As_2S_3$), also called ruby silver ore, contains 65.5 per cent; stephanite ($5Ag_2S_1Sb_2S_3$) 68.5 per cent and polybasite ($Ag_9S.Sb_2S_3$) nominally contains 75.6 per cent silver, but usually part of the silver is replaced by copper and part of the antimony by arsenic. These double sulphides at American silver mines seldom occur in bodies of sufficient size and purity to be worked alone, but are not uncommon. One or more are found at mines in Montana, Idaho, Utah, Colorado and Arizona. Large masses of pyrargyrite have been taken from mines in the state of Guanajuato, Mexico. Mention may be made of the mines in the Ruby district of Gunnison County, Colo., and at Silver City, Idaho. The silver ores usually occur in veins or in irregular replacement deposits formed by hot magmatic waters in the vicinity of igneous intrusions.

Silver being a precious metal a small per cent of it in lead or copper ores makes it the metal of chief value. Even when it is the metal of lower value a few ounces in a ton of ore means the difference between profit and loss in working a mine. Of the lead-silver ores by far the most important is galena, lead sulphide (PbS). Practically all galena contains silver, the extremes being represented by galena from Carinthia, Austria, containing .05 ounce per ton, and from Idaho, up to 2,040 ounces per ton. In galena the silver is present either as isomorphous silver sulphide or some finely disseminated silver mineral. In oxydized lead ores, cerussite, etc., the silver is mostly present as chloride. Of the strictly copper silver ores, the most important is tetrahedrite, or gray copper ore, which is essentially a sulphide of copper and antimony ($4CuS.Sb_2S_3$), though actually of very varying composition, and the related mineral tennantite ($4Cu_2S.As_2S_3$), also called gray copper. These minerals are of common occurrence in Gunnison, Clear Creek, Summit and Gilpin counties, Colo. Silver is also found associated with chalcopyrite, chalcocite, bornite and other copper minerals, also with iron pyrite, zinc blende, hematite and various minerals, all of which may be classed as silver ores when the percentage of silver is enough to make its extraction profitable. To-day the largest part of the world's silver supply comes from mines not worked for silver alone but rather for gold, copper or lead, the silver being a by-product. Thus it happens that the operation of many silver-producing mines and the resulting output of silver depend not on the market price of silver but on the price of lead or copper. This is not true, however, of the Cobalt district, Ontario, where silver is the leading metal and cobalt and nickel are by-products.

Metallurgy of Silver Ores.— Silver ores as previously noted may be divided into silver ores, proper, silver-lead and silver-copper ores. They may also be divided into (1) free-milling; (2) refractory and (3) smelting ores. The first includes native silver, also the chloride and bromide of silver, the metal being extracted by its forming an amalgam with mercury. In so-called refractory ores, usually silver sulphide with or without the sulphides of arsenic and antimony, the ores are roasted with salt or otherwise treated prior to amalgamation. The smelting ores include particularly silver-lead and silver-copper ores. The oldest of the methods of extracting silver by amalgamation, one still used in Mexico, is the patio process. In this the ore is coarsely crushed by stamps or by a Chilean mill, then transferred to an arrastra, a circular space paved with stone, where the ore mixed with water is ground fine under heavy stones drawn around by mules. By the addition of mercury all gold and free silver are extracted. The wet ore is then spread on the patio or amalgamating floor, thoroughly mixed with 3 to 5 per cent of salt, by mules treading it, allowed to stand a few days and then copper sulphate and mercury are added and the ore well trodden for several days, mercury being added from time to time to collect the silver as an amalgam. The chemical reactions which take place are complicated. Finally the mass is washed to remove non-metallic material, the heavy silver amalgam is collected and the mercury recovered by distillation, leaving the silver. Of the modern amalgamation processes the Washoe was developed for treating the complex silver-gold ores of the Comstock lode. The ore was broken in a crusher, reduced to pulp by stamps and then transferred to iron pans four to six feet in diameter, known as amalgamating pans. The pans had a false bottom or die, on which revolved an iron plate, or muller, having cast-iron shoes. The ore pulp, one to three tons, with the necessary amount of salt, copper sulphate and mercury, was heated with a steam coil or by blowing in steam and ground three to five hours. Then the light material was washed away and the amalgam collected. Various modifications of the Washoe process have been devised and there are still many mills using some form of pan amalgamation, but the extraction is usually not very high. Silver chloride is soluble in a saturated soluble solution of salt and more soluble in sodium hyposulphite. Hence processes have been devised which aim to convert the silver in an ore to a chloride by roasting with salt, and then remove it by leaching. In the Augustin process the roasted ore is leached with a solution of salt, and in the Russell process with sodium hyposulphite and cuprous sodium hyposulphite. Neither process is now in use in the United States.

Smelting, where practicable, has the advantages of simplicity, speed and often high extraction as compared with all other methods of treating ores not free-milling. It is the regular method of treating lead-silver and copper-silver ores. Lead ores are smelted in the usual way (see LEAD); the silver goes into the lead and is recovered by the zinc, or Parkes, process. In the copper ores (see COPPER) the silver goes with the copper and may be separated by electrolytic refining. Gold-silver alloys obtained from milling or smelting ores of many varieties are also treated electrolytically (see GOLD). The silver obtained from some silver-lead ores is often purified by cupellation. A small reverberatory furnace with a hearth of bone ash is used. The lead bullion is melted, the lead oxydized to litharge by a jet of air until the silver bath is clear, then the silver is cast in molds forming silver pigs or bars. Many ores carrying silver go to concentrating mills equipped with jigs, vanners, etc., for separating the ore from the gangue. The concentrates thus obtained are usually smelted.

Silver Producing Districts.—A large producer of silver is the Broken Hill Proprietary Co., of New South Wales, Australia. The once famous Comstock lode mines in Nevada, which produced ore carrying values of two parts gold to three parts silver, are now unimportant, and probably the largest individual silver producer in the United States is the Amalgamated Copper Co., the silver being a by-product of its mines at Butte, Mont. Leadville, Colo., is an important silver-producing camp, but the ores are now generally low-grade. Silver Cliff and Aspen, Colo., were noted for their output of high-grade silver ores. In Utah the mines at Park City, notably the Daly West, are large producers of silver, though the ores also contain gold, lead and copper. In Idaho the silver-lead mines of the Cœur d'Alene region produce in the aggregate much silver. In Mexico the states of Chihuahua, Durango, Guanajuato and Hidalgo all contain important silver-gold or silver-lead mines. The mines of Guanajuato are estimated to have produced one-sixth of the silver of the world and the Valenciana has an established record of production of 300,000,000 ounces. In South America the once famous mines of Cerro de Pasco in Peru are to be worked again by a New York company, but chiefly for copper. The silver output of the Cerro de Pasco mines from their discovery in 1630 up to 1886 is estimated at 462,250,000 ounces. In Ontario, Canada, the Cobalt District is one of the world's leading silver camps. In Europe, Germany is the most important silver-producing country, the metal coming from the Manusfield copper mines, the silver-lead mines at Mechevnich and the mines of the upper and lower Harz.

The world's production of silver in 1908 amounted to 203,186,370 troy ounces, valued at $108,684,400. Mexico that year led the world in silver production, and Mexico and the United States together produced nearly 70 per cent of the total output. Estimates based on the most reliable information gave the world production of silver for the calendar year, 1917, by countries, as follows:

COUNTRY	Ounces, fine	Value ($0.89525)
North America — United States	71,740,400	$64,225,593
Canada	22,151,000	19,830,683
Mexico	31,214,000	27,944,333
Total	125,105,400	$112,000,609
Central American States and W. Indies	2,369,500	$2,121,295
South America — Argentina	29,000	$25,962
Bolivia	2,435,200	2,180,113
Brazil	25,000	22,381
Chile	1,672,200	1,497,037
Colombia	325,000	290,956
Ecuador	45,000	40,286
Peru	11,000,000	9,847,750
Guiana — British	8,000	7,162
Venezuela	3,300	2,955
Total	15,542,700	$13,914,602
Europe — Austria-Hungary	1,500,000	$1,342,875
Great Britain	86,000	76,991
Greece	350,000	313,337
Italy	450,000	402,863
Norway	282,000	252,461
Russia	500,000	447,625
Serbia	20,000	17,905
Spain	4,500,000	4,028,625
Sweden	35,000	31,334
Turkey	400,000	358,100
Total	8,123,000	$7,272,116
Australia — New South Wales	2,800,000	$2,506,700
Queensland	240,000	....
Victoria	29,000	....
Western Australia	221,800	25,962
New Zealand	780,000	198,567
Tasmania	....	698,295
Total	4,070,800	$3,644,384
Asia — British India	600,000	$537,150
China	63,400	56,759
Chosen	28,000	25,067
Formosa (Taiwan)	50,000	44,763
Indo-China	1,000	895
Japan	6,844,500	6,127,538
Total	7,586,900	$6,792,172
Africa — Belgian Congo	10,300	$9,221
Egypt	900	806
Madagascar	20,000	17,905
Portuguese East Africa	1,200	1,074
Rhodesia	212,000	189,793
Transvaal, Cape Colony and Natal	950,000	850,488
West Africa (Gold Coast)	....	....
Total	1,194,400	$1,069,287
Total for world	163,992,700	$146,814,465

With the exception of the years 1895 and 1902 when Mexico first led, the United States led the world in silver production for over 30 years up to 1902. Of the continents North America is easily first, with Europe now second.

The output of the chief silver-producing States of the Union in 1917, according to reliable authorities, was approximately as follows:

STATE OR TERRITORY	Silver	
	Fine ozs.	Value
Alabama	....	....
Alaska	1,351,100	$1,112,600
Arizona	8,183,200	6,738,900
California	1,989,800	1,638,600
Colorado	8,163,600	6,722,700
Idaho	11,683,100	9,621,000
Illinois	3,300	2,700
Maryland	1,100	900
Michigan	686,700	565,500
Missouri	21,100	17,400
Montana	13,711,100	11,291,100
Nevada	11,441,000	9,421,700
New Mexico	1,313,700	1,081,800
North Carolina	2,800	2,300
Oregon	215,700	177,600
South Dakota	191,100	157,400
Tennessee	99,300	81,800
Texas	583,200	480,300
Utah	14,315,300	11,788,700
Vermont	400	300
Virginia	9,400	7,700
Washington	257,000	211,600
Wyoming	4,900	4,000
Philippines	16,600	13,700
Total	74,244 500	$61,139,600

Uses of Silver.— Silver is used for coinage and for ornamental articles, while the chloride, bromide and iodide of silver are of great importance from their use in photography. Articles plated with silver are in common use, as the cost of plating is small if the film of silver deposited is thin. A solution of the double salt potassium silver chloride(KCN.AgCN) is used, from which the silver is readily deposited. The articles to be plated are thoroughly cleaned, attached to the negative pole of an electrical circuit of low voltage and immersed in the bath, a silver plate being attached to the positive pole. The silver as deposited has a dead surface but is made bright by burnishing after removal from the bath.

In photography silver chloride in a layer of albumen or gelatine is used on the ordinary printing papers; various organic compounds are formed which are changed on exposure to light, and this change is shown by the action of certain reducing agents, developers, the resulting image being formed of unknown silver salts suspended in the gelatine. In bromide prints which are more durable, the image is due to finely divided metallic silver. In the ordinary photographic dry plates, silver bromide or iodide is used in a gelatine film, as these salts are more easily affected by light. See BIMETALLISM; COINAGE; ELECTROCHEMICAL INDUSTRIES; COPPER; GOLD; LEAD; PHOTOGRAPHY.

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SILVER, Fulminating. See EXPLOSIVES; FULMINATES.

SILVER, Refining of. See ELECTROCHEMICAL INDUSTRIES.

SILVER AGE, the designation applied to the second mythological period in the history of the world, under the care of Jupiter. It succeeded the Golden Age. The phrase is also applied to a period of Roman literature succeeding the most brilliant period, and extending from about 14 A.D. to 180 A.D.

SILVER CITY, N. M., city and county-seat of Grant County, 185 miles southwest of Albuquerque, on the Atchison, Topeka and Santa Fé Railroad. The city is important as a health resort, particularly for tubercular cases, and has several private sanitoria. The United States military hospital is at Fort Bayard, nine miles distant. The surrounding country is occupied in stock-raising and there are valuable gold, silver, copper, zinc, lead and turquoise mines. The New Mexico Normal School is located here. Pop. 3,217.

SILVER CREEK, N. Y., town in Chautauqua County, on Lake Erie, 20 miles southwest of Buffalo, and on the Lake Shore and Michigan Southern and the New York, Chicago and Saint Louis railroads. It is situated in a vineyard district, has natural gas and manufactures furniture, United States post office canceling machines and grain-cleansing machinery. Pop. 2,512.

SILVER FOX, a glossy black variety of the Canadian red fox (*Vulpes fulvus*) with a silvery grizzle on the forehead, and on the flanks passing upward to the rump. It is extremely rare in the wild state and the fur is very valuable. In Prince Edward Island and elsewhere in Canada and northern United States great numbers of this species are now bred in enclosures and reared for two years, when they are killed for their fur. See FUR FARMING.

SILVER GRAYS. See WHIGS.

SILVER QUESTION. See BANKS AND BANKING; BIMETALLISM; BRYAN, WILLIAM JENNINGS; DEMOCRATIC PARTY; MCKINLEY, WILLIAM; MONEY.

SILVER SPRING, Fla., a famous spring in Marion County, 14 miles northeast of Ocala, emptying into Ocklawaha River through Silver Creek Run, a stream nine miles long, of crystal transparency, and of sufficient depth to permit river steamers to navigate to the spring itself. The spring is about 200 feet wide and discharges daily more than 300,000,000 gallons of water of a uniform temperature of 72.2° F. The water rushes up through fissures in the limestone rock, there being five principal openings and many of smaller size, and keeps in constant agitation the bed of white sand. The water is unfit for drinking purposes owing to certain mineral qualities, but is so clear that the bottom of the spring may be seen at depths from 60 to 80 feet. There are several similar springs in Florida, but Silver Spring is most accessible and best known, a railroad running to it in addition to its steamboat connection. The spring is said to have been visited by De Sota, and to have been the «Fountain of Youth» of Ponce de Leon's search.

SILVER STANDARD. See BIMETALLISM.

SILVER WEDDING. See WEDDINGS.

SILVERBERRY. See OLEASTER.

SILVERING. See GILDING.

SILVERINGGLASS. See MIRROR.

SILVERMAN, Joseph, American rabbi: b. Cincinnati, Ohio, 25 Aug. 1860. He was graduated at the University of Cincinnati in 1883 and later studied at the Hebrew Union College, where he took his D.D. in 1887. He was ordained in 1884 and was minister to congregations in Texas in 1884–88. Since 1888 he has been rabbi of Temple Emanu-el, New York. He was president of the Central Conference of American Rabbis in 1900–03; organized the Emanu-el Brotherhood; is a trustee of Hebrew Union College; and in 1913 was associate editor of the *Peace Forum.* He contributed to the 'Encyclopedia Americana' and is author of 'Catechism on Judaism' (1896).

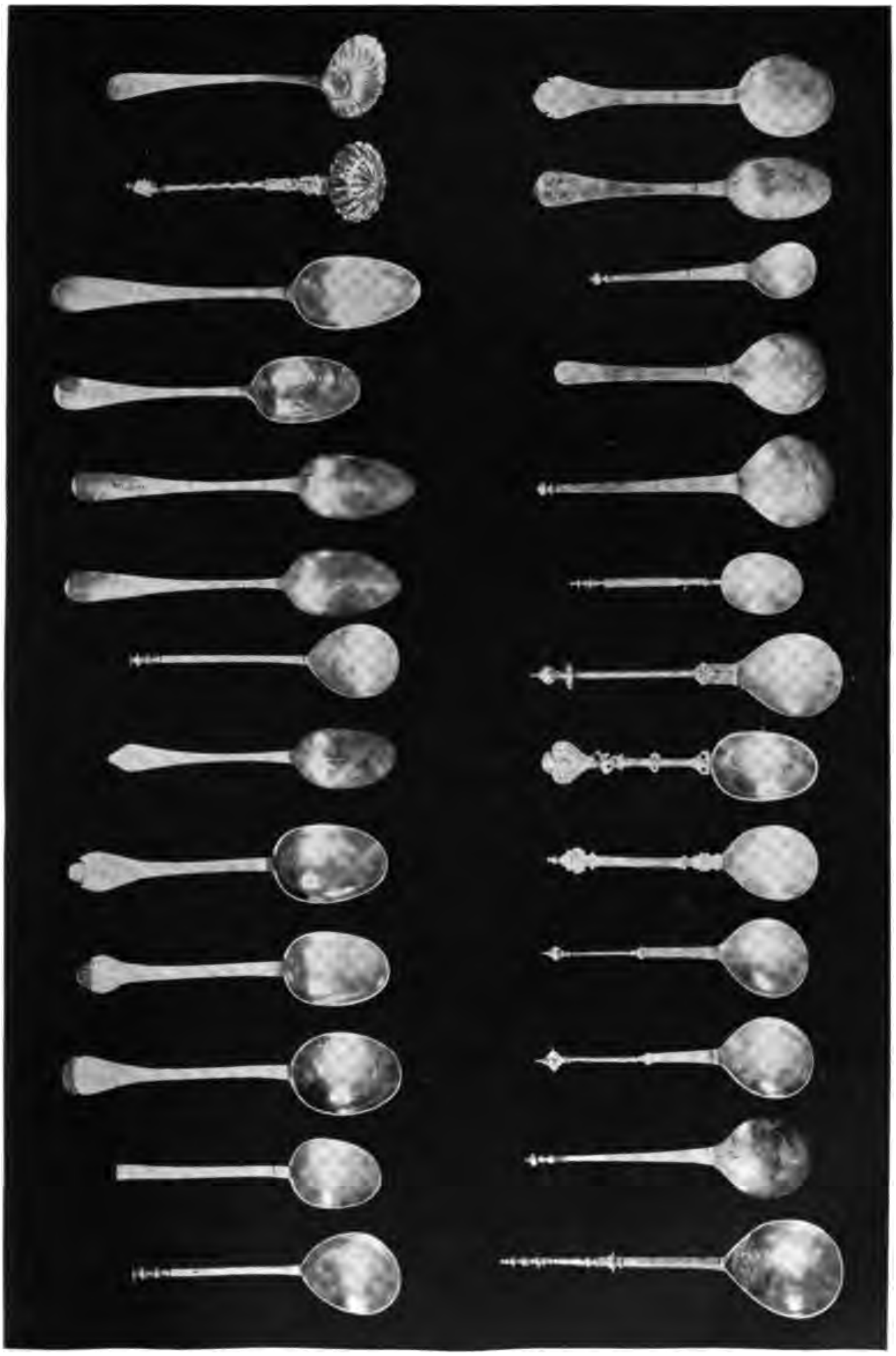
SILVERSIDE, a name given to various small fishes because of their bright silvery color and especially to members of the family *Atherinidæ* of the order *Percesoces.* These fishes have the third upper pharyngeal bone enlarged, slender and elongated bodies with rather large, easily detached cycloid scales. The spinous dorsal fin is weak and well separated from the soft dorsal, the ventral fins are on the middle of the abdomen and the pectorals at a high level. Most of them are small carnivorous fishes living in schools in shallow bays of the sea, but a few are fresh-water. They are important chiefly as food for other fishes, but several of the larger ones are valued as human food. Fifteen genera and 60 species have been enumerated, most of which are North American. They abound especially in the Gulf of Mexico. *Menidia notata* is the form best known along the coast of the New England and Middle States, where it abounds. It is a delicate translucent little fish of a greenish color, has a conspicuous lateral silvery band and is found everywhere along the shores in large schools. They may be fried to a crisp and eaten whole like smelts. The brook or lake silverside (*Habidesthes sicculus*) is found abundantly in ponds and sluggish streams throughout the Mississippi Valley and Southern States, and is often called skipjack. Consult Jordan and Evermann, 'Food and Game Fishes' (New York 1903).

SILVERWARE. Frequently termed *plate* or *silver plate.* From the nature of the use to which articles composed of silver are put they are often classified under such heads as ecclesiastical and civil, or ecclesiastical, municipal and domestic. The usual styles of manipulation of the metal in producing silverware are hammered or repoussé, engraved, chased, enameled, etc.

Antiques.— It was a very frequent condition of the troublous early periods of European history that the inhabitants of a castle or small town had to migrate, taking what wealth they had with them. The Roman invaders' generals often carried with them on their campaigns large services of silver for their camp life. Frequently such migratory hordes were attacked and overwhelmed, and, if time permitted, they hurriedly buried their most valued possessions. To such action we owe much treasure-trove and from the «finds» we learn to what a marvelous perfection the ancients brought their silver plate. Among the most important discoveries by accident of such hidden wealth are the following: The «Treasure of Bernay,» discovered (1830) at Berthouville, Normandy, contained 69 pieces, weighing about 55 pounds, of beautifully wrought, embossed, decorated silverware. Part belonged to the treasury of a temple of Mercury at Canetum 2,500 years ago. Two ewers (*œnochoe*) had chased subjects from the 'Iliad' and the history of Achilles, the Greek hero. One of these pieces contains fine depictions of no less than 42 personages. The collection is in the Bibliothèque Nationale, Paris. The pieces are of different dates — before the Roman Empire up to the 3d century A.D. Another wonderful buried collection of silverware is the «Hildesheim Treasure,» now in the Antiquarium Museum, Berlin, discovered in 1868. It consists of 74 pieces; drinking vessels and table utensils, mostly well preserved and belonging, probably, to the 1st century A.D. The decoration is in Greco-Roman repoussé work of the most exquisite description. Replicas of this treasure are in the Metropolitan Museum of Art, New York. Another remarkable silverware discovery was that known as the «Boscoreale Treasure.» It was discovered in 1895 in a buried Roman villa near Pompeii. The lovely workmanship and design point to the last years of the republic, some to the first years of the empire. It contains 98 pieces of silverware in beautiful repoussé decoration; cups, vases, phials, shallow dishes, casseroles, spoons, mirrors, etc. A very fertile field of discovery of buried ancient silverware is the Crimea, where a large amount of treasure has been unearthed (mostly now in Petrograd) from burial grounds of the Scythians. They date from 2,500 to 3,000 years ago and are of Greek workmanship.

History.— The story of craftsmanship in the precious metals of the Middle Ages is largely one of furnishing of gold and silver ecclesiastical pieces for the Church and its services. With the growth of wealth of royalty and nobility from lack of banking facilities, much of the saving was turned into gold and silversmiths' work. Starting about the 13th century we find the almory containing more precious wares of the family. The cupboard consisted of boards placed on trestles to hold and display the wealth in silver cups and other wares of the family. This easily portable furniture gave way, in times of peace, to a made-up «dresser» of so many «stages» or shelves on which to «dress,» or display, the silver services and show-pieces. With greater refinement arrived the «sideboard» or «credence» for the same purpose, to be followed by the «buffet.» The number of «stages» kept increasing as the wealth in plate grew, till royalty imposed an edict against the extravagance and restricted the number of shelves according to the rank of the owner. By the 16th century the hoards of plate were enormous. In England Henry VII left over $10,000,000 worth; the cupboard of Henry VIII had seven tiers of plate; and so it was in other countries, especially Spain. Immense quantities of silver were arriving in Europe from conquered Mexico and Peru; the silver mines of Potosi alone had brought to Spain by 1633 no less than 845,000,000 pesos. Italy in her Renaissance brought forth many great artist-goldsmiths (see GOLDSMITHING) but perhaps, her most noted service of silverware is that produced by Benvenuto Cellini. It is in the Pitti Palace, Florence, and consists of 12 tazze, each tazza representing a month in the year. Germany had, in the 16th century, centres for gold and silver smithing at Augsburg and Nuremberg. Her taste was running to quaint forms and decoration such as cocoanut shell and ostrich shells mounted as cups, other standing cups had bodies of pineapple (*ananas*) form, others again were studded with hemispherical or pear-shaped protruberances. Wentzel Jamnitzer, throwing aside the Gothic, often assumed Renaissance tendencies in his remarkable pieces. Mathias Walbaum and Hans Petzolt gained fame for their silvsmiths' work in the 17th century; Dinglinger did fine silver work on table centrepieces, etc., in the 18th century. In France, already in the 13th century, Philippe le Hardi granted his silversmith (*argentier*) Raoul letters of nobility. The dukes of Bergundy by the 15th century gloried in amassing great collections of gold and silverware. Louis, Duke of Anjou (14th century), had *nefs,* standing salts, enameled flagons, fountains, *coupes,* goblets, basins, even kitchenware, of silver. In 1360 the city of Paris presented Jean le Bon with a gift of silver vessels. By the 17th century France had become famous for her articles in the precious metals (see GOLDSMITHING) and their makers, all pieces to be swallowed up in the melting pot for war purposes. The following century under the regent, Louis XV, Louis XVI and Napoleon, the royal factory of the Gobelins produced magnificent wares in the precious metals. Paul Lamerie, the French silversmith, went to England in 1712 and produced prolifically in London for 40 years. His silver pieces show sober, artistic decoration for a long time, then he gave way to the demand for over-elaboration of ornament, later to come under the sedate ruling of the Greek Classic style. Under the brothers Adam silverware underwent a great reform in the 18th century; tea and coffee urns, ewers, sugar bowls, creamers, etc., came under the influence of the Greek art wares being excavated at Pompeii and Herculaneum. The great rarity of examples of silverware of certain periods is accountable from the fact that warfare, at times, called for all the precious metals available to help out

SPOONS



Above: English Types (17th, 18th and 19th Centuries)

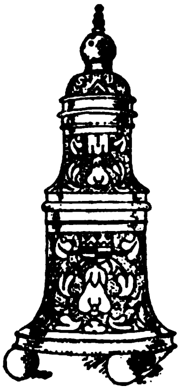
Below: German and Dutch Types (17th, 18th and 19th Centuries)

the empty treasuries. In 1521 François Premier ordered his subjects to send their silverware to the mint. The «grande Fonte» under Louis XIV lasted six months (1688-89) and was the most prodigious in destructive power. Great pieces of massive silver furniture as well as table services (the king's treasure alone had cost over 10,000,000 francs and fetched only 3,000,000 francs in coin) were sacrificed. The year 1760 witnessed once more the journey to destruction of France's best plate, and in 1790 came the voluntary «patriotic fonte.» In the Wars of the Roses in England so much plate was destroyed that examples of silver plate antedating 1500 are very scarce. The Reformation (16th century) swept away all the silverware discoverable. Charles I of England, in 1643, to replenish his empty treasury, ordered that all silverware be melted down and paid for at five shillings per ounce; 12 Oxford colleges contributed 1,610 pounds per week, and the gentry 700 pounds each week. Coming down to strictly modern times, we must deplore the fact that 19th century Europe and England in the Victorian period were in a decadent stage in art work and silverware followed the vulgarized styles. France with her «nouveau art» and Germany with her «Jugend» style have struggled but not succeeded in reaching any admirable stage of art production.

Silverware Products.— Ecclesiastical pieces made of silver or silver-gilt are candle-sticks, censers, incense boats, chalices and patens, pyxes, monstrances, bells, crosses, croziers, acolyte standards bearing candles, ewers, cruets, alms dishes, ablution bowls. The chalice is composed of a bowl (usually hemispherical or slightly elongated), a stem having, half way down, a «knop» or protuberance, and a flaring foot. While the bowl is nearly always plain (so as to be easily kept clean), the rest of the piece is elaborately ornamental. In the Protestant Church the communion cup takes the place of the chalice. It is frequently chalice-shaped but more often has the form of a goblet, a tankard or a beaker. The flagons, tankards and beakers found in church plate have frequently been made for profane use, but as articles of beauty and value have been dedicated by will to the Church.

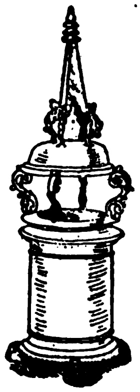
Municipal Plate.— Every guild (from goldsmiths' to tinsmiths') in Europe has its treasure of plate which is displayed on the table at banquets and other civic functions. And the large amount and high quality of the ware found even in obscure towns is often a surprise to the stranger; such property is, however, usually the accumulation of centuries of presents made by the wealthy in each generation. Every town hall (Rathshaus or hotel de ville) has a large array of plate services as well as magnificent show pieces. The colleges pride themselves on their great silver and gold services.

Domestic Plate.— Chief pieces used in the last centuries in domestic circles are ewers, beakers, bowls, caudle cups, cruet stands, flagons, hanaps, tankards, monteiths and other punch-bowls, urns, salvers, posnets, trussing cups, porringers, tumblers, goblets, wager cups, tasters, etc. Earliest forms of coffee pots date from 1670 to 1681; earliest teapots date from 1717; to such services belong, later, creamers, milk pitchers and sugar bowls. Forks at first had two prongs and were used only for eating fruit; the four-pronged fork came into use first in 1682. Silver spoons of a highly artistic form («keel and disk») were made in Greco-Roman times. In the study of spoons in the centuries

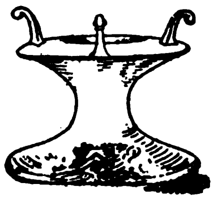

Bell Salt, dated 1608

Epergne by Wentzel Jamnitzer, (about 9 inches high) in Louvre (Paris) German, showing Renaissance tendency.

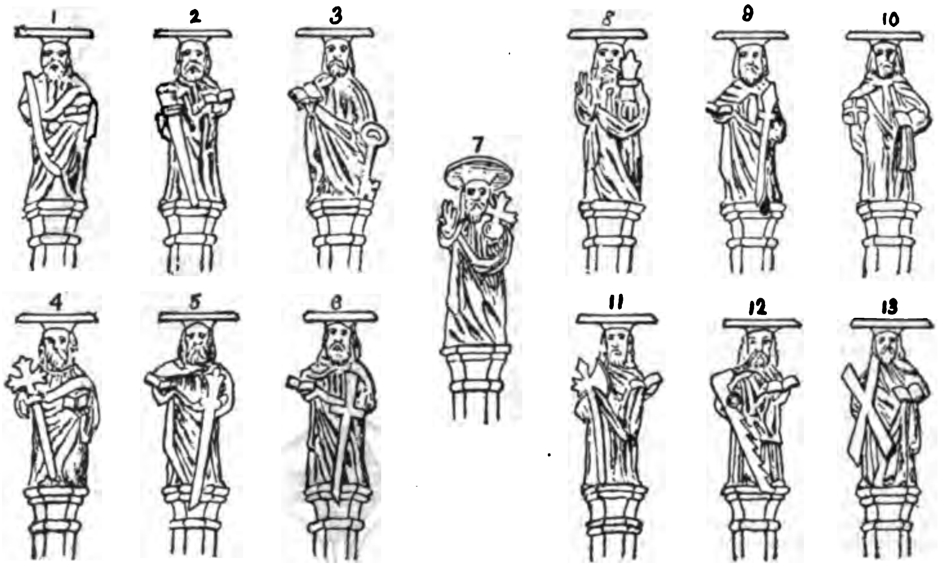
Hour-Glass Salt. 15th Century.


Steeple Salt, dated 1626.

Cylindrical Salt, dated 1567.


Napkin Salt, dated 1664.

the style of «knop» or finial of the handle defines the period, besides the changing in shape of the bowl. As to these knop styles, we read in 1446 already of the «maidenhead» spoon; other varieties follow: Acorn, diamond point, fruitlet, writhen, strawberry, death's head, slipped-in-the-stalk, Puritan, scallop-shell, owl, lion-and-shield, Pudsey, seal-top, capital, baluster, pied-de-biche, etc. The 17th century spoon handle was joined to the bowl in a diminishing prolongation down the back of the bowl; this is known as the «rat-tail» spoon. Early spoon bowls run to «fig-shape,» then oval, then inclining to be pointed at lower end. Greatly prized of collectors are the souvenir birth-spoons termed «Apostle» spoons, each dedicated and having as finial a representation of one of the apostles. Actual pieces of art, frequently are the nefs (formed, like ships), epergnes, standing salts (hour-glass salts, cylindrical salts, bell salts, steeple salts, napkin salts, etc.).

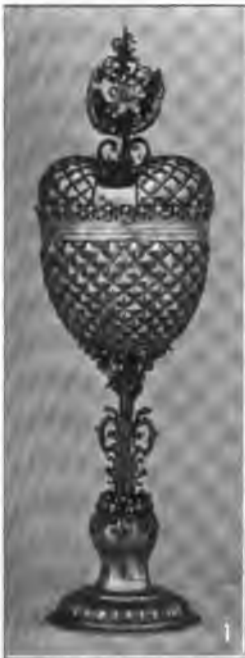


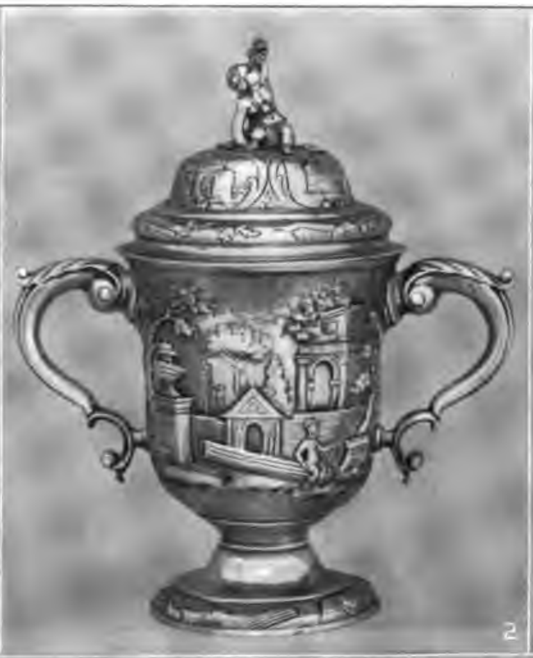
Full Set of Apostle Spoons, in Goldsmiths' Hall, London. Dated 1626.
Only full set of one date known. (1) Saint James the Less. (2) Saint Bartholomew. (3) Saint Peter. (4) Saint Jude. (5) Saint James the Greater. (6) Saint Philip. (7) The "Master." (8) Saint John. (9) Saint Thomas. (10) Saint Matthew. (11) Saint Matthias. (12) Saint Simon Zelotes. (13) Saint Andrew.

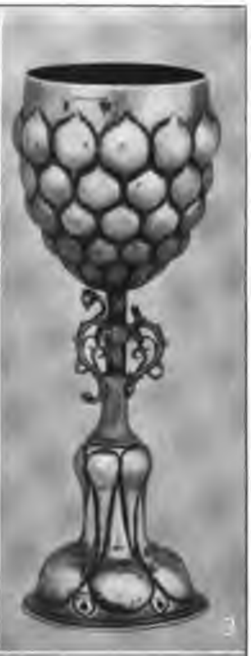
«Hall» and Other Marks.—A very important feature to collectors of silverware is the fact that all of it is *marked* since the 14th century by law. In 1313 Philippe le Bel, king of France, ordered that all gold be stamped with the punch (*poinçon*) of the Goldsmiths' Company of Paris. The «touche de Paris» in this law became the recognized English standard for sterling silver. Edward I, in 1300, had bestowed the privilege of assaying the precious metals to the London Goldsmiths' Company. Punch marks used on English plate are: (1) Standard — a lion passant in England, a lion rampant in Glasgow, a thistle in Edinburgh, a crowned harp in Dublin. (2) Duty mark — head of reigning sovereign (figure of Hibernia in Dublin). This mark was added in 1874 till 1890, when duties were abolished. (3) Date letter (or «annual» letter). Its starting point is not known; first mention is in 1537. The «annual letter» alphabet has but 20 letters — J, U, W, X, Y, Z are omitted. Since 1560 they have been enclosed in regular heraldic shields of various shapes; before then a line roughly outlining the letter was used. The change to another style alphabet has proceeded regularly every 20 years from 1478 till 1696, when a fresh alphabet was used. (4) Place-mark of assay town. (5) Maker's mark — enforced, in England, since 1363 required each silversmith to have a mark of his own. Symbols, emblems or initials were used at first; from 1697 to 1720 the first letter of the surname was used alone, but from the latter date to 1739 one or two initials were used indiscriminately. Then the «initials of their Christian and surnames» was ordered and continued to this day. In 1675 the law enforced that «all manner of silver vessels be assayed at Goldsmiths' Hall» and be approved by striking each piece with the lion's and leopard's head, crowned, or one of them. From 1697 to 1720 the lion's head erazed and Britannia were used instead of lion's head and lion passant.

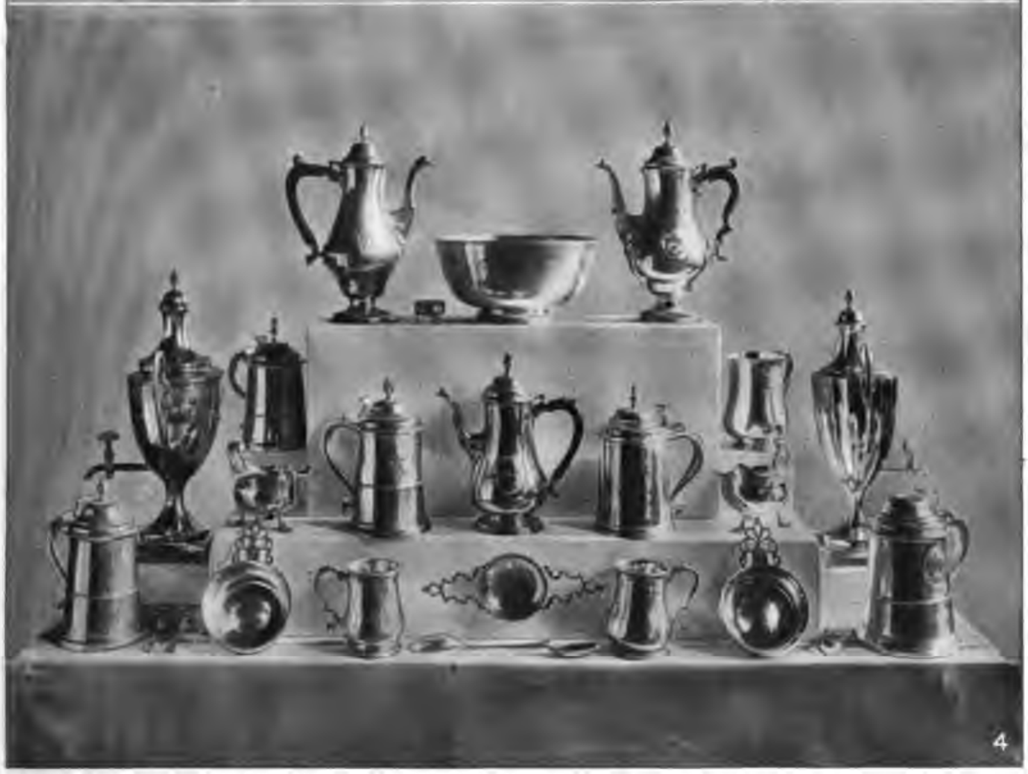
Sheffield Plate.— The discovery of the process used in the production of this ware was made by a Sheffield cutler, Thomas Boulsover (often misspelled Bolsover), in 1742. He found that a layer of silver could be welded to a copper plate by heat and pressure. He appears to have made only plated buttons and small ware. Joseph Hancock soon advanced the method into the making of table services and larger pieces. The silver fused to the base metal was standard 925 alloy. This early ware was plated only on one side; «double-plating» (on both sides) started some time between 1763 and 1770. To hide the central layer of copper exposed on the edge it was necessary to attach a border or edging. This edging was first produced by placing the copper sides of

SILVERWARE



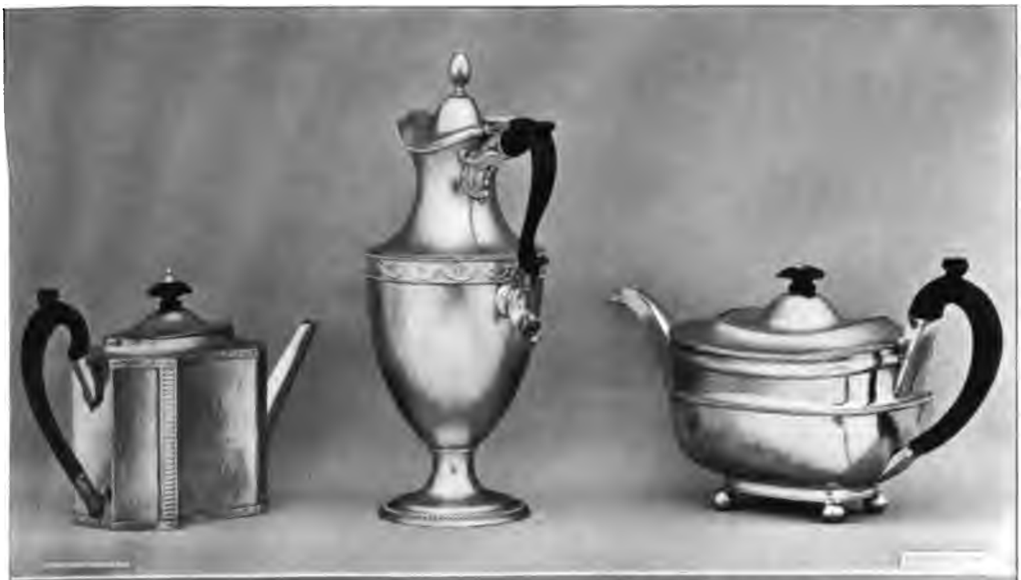




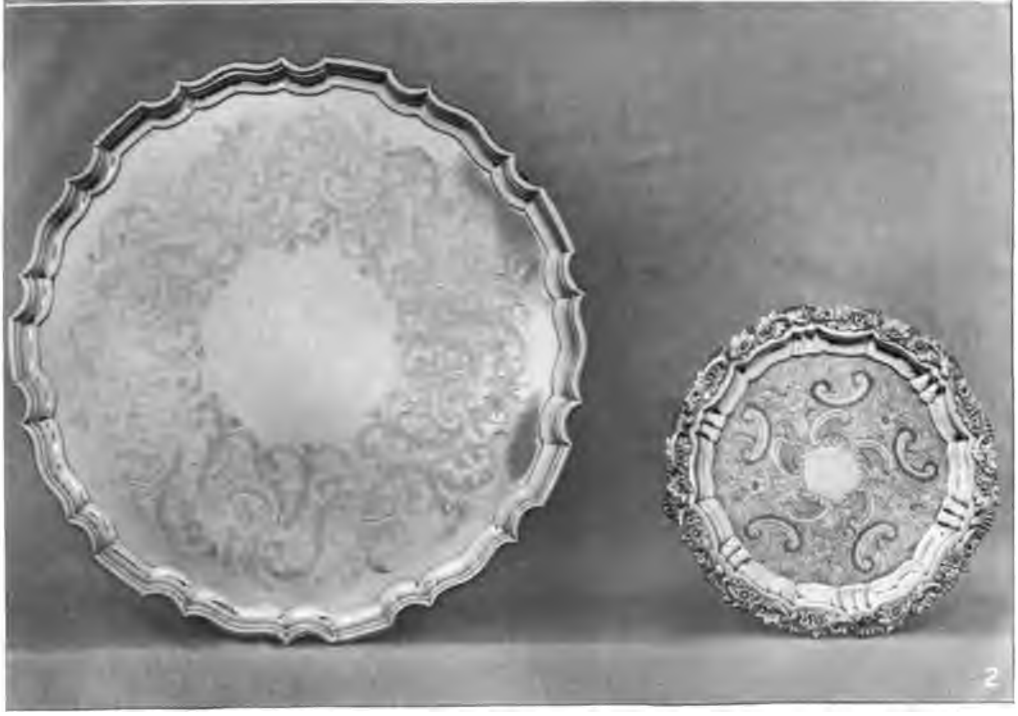


1 Hanap, Nuremberg, 1st half of 17th Century
2 Two-handled Loving-cup. London, 1743
3 Standing cup, Augsburg, Early 17th Century. In New York Metropolitan Museum of Art
4 Old American Silverware. Pieces by Paul Revere in Exhibition at the Boston Museum of Fine Arts

SILVERWARE



1 Teapots, English Sheffield Plate, 18th Century



2 Salvers, English Sheffield Plate, 19th Century

two pieces back to back and solder-tinning the edges (1755–85). Cadman then invented the system of soldering on a solid silver edging shaped to fit. The «edgings» of Sheffield plate are one of its chief characteristics. Starting with simple silver ware («thread») edges or borders, by 1820 highly ornate, heavy, deep relief scroll-work and bold designs became vogue. It is the renowned «Georgian» style. The *flat-chased* large trays and salvers dating between 1815 and 1830 are probably (if in good condition) more prized than any other pieces of «Old Sheff» ware. From 1830 to 1840 is the «transition period» when *German silver* and other light-colored alloys took the place of copper as a base. The enormous demand for fine Sheffield plate ware in the period is easily conceivable when we remember that the great difference in cost brought fine silver services within the reach of many thousands of the middle classes who had been using pewter and earthenware. The beauty of some of the elaborate creations brought about by the immense and profitable sales made the nobility and gentry converts to its prestige, even royalty took to the majestic épergnes, tea and coffee «equipages» (consisting of urns for hot water, tea and coffee) which were more attractive than any solid silverware ever before produced. But the brothers George and Henry Elkington, of Birmingham, invented a method of silver deposition on base metal by electric current. After patient perfection of their process they obtained, in 1840, a patent for the electro-plating process as done at this day. The extremely low price at which base metal pieces could be produced with a precious metal surface of any desired thickness quickly killed the Sheffield plate business and rapidly evolved a great industry.

Colonial Silverware.— Much early silverware found in the New England States was imported from France and England. But the silversmiths of this country grew in number with the increase of wealth of the colonies. Boston and New York were the producers of most of this early American plate, but there were a number of workers in silver (strange to say, many of them were blacksmiths as is shown by contemporary documents) in Connecticut who did very fine workmanship in silver vessels as recent displays of extant 17th and 18th century pieces prove. Philadelphia, Baltimore, Albany and Troy also boasted of their clever silversmiths in those days. Building up a historic outline from researches made recently we are arriving at many interesting points on colonial silver ware and its makers. The earliest Connecticut silversmith recorded appears to be Job Prince of Milford (born about 1680, died about 1703); next comes René Grignon (Huguenot), who settled in Norwich before 1708. Daniel Deshon was Grignon's apprentice and went to New London. Cornelius Kierstead was a New Yorker but (about 1722) worked in New Haven, Hartford, New London, Norwalk and Waterbury. John Hull (1624–83) was a wealthy Massachusetts silversmith and his ability is shown in existing communion cups in the First Church of Boston. He became «Mint master of Massachusetts» and made silver money for local circulation, the British coin being almost entirely absent. He set up (1652) a mint in Boston (disregarding the English Crown's sole right to coin money). Hull got one shilling of every 20 coined. The «Pine-tree» shilling was coined for 30 years and Hull got so wealthy he became a banker as well as silversmith. David Jesse worked in Boston early in the second half of the 17th century — a beaker of his dated 1672 is one of the oldest American pieces existing. Jeremiah Dummer (1645–1718) of Boston has left us a number of pieces. John Cony (1655–1722) also worked in Boston and had as apprentice Apollos Rivoire, who came to Boston from Germany. He had a family of 12, of which the noted patriot Paul was third. The latter started work in his father's shop and was but 19 when his father died (1754). Paul Revere's (the family name was changed) historical career is too well known to repeat here. Many of the Revere pieces exist; 65 pieces appeared in one Boston exhibition (1906). Unfortunately there is little to prove which signed pieces belong to father or son. One very small salt has the inscription «The Illustrious Ninety Two,» referring to the 92 members of the house of representatives of Massachusetts who refused their signatures for rescinding the circular letter sent to the sister colonies to all join action. Another piece of historic note is Revere's punch-bowl ordered by the 15 Sons of Liberty, their names encircling its rim. We have the names of numerous New York silversmiths of early days but their wares have disappeared. Other early silversmiths worth mention are Beach, Ward, Sargeant, Pitkin and Rogers of Hartford, and Merriman, Gorham, Chittenden, Bradley and Brown of New Haven. By 1715 Connecticut citizens were wealthy enough to be buying coffee and chocolate pots, braziers (forerunners of our chafing dish), elaborate urn-shaped loving cups, porringers, patch boxes, snuff boxes, caudle cups, etc. The early pieces (17th century) were few and simple (both church and domestic), beautiful ware; gradually came the advance to more elaborate forms and a greater variety of articles. One cause of a reduced number of extant pieces was the early 19th century prohibition movement which melted down drinking vessels to make spoons out of the metal. Modern American silverware holds its own to the present day compared with that of other lands as has been proven at many World's Fairs. The products of Tiffanys have shown many charming and original creations and the Gorham Company at its Providence shops has made a world-wide reputation with its *martelé* style of ware. This style shows the hammer marks as so many facetted surfaces for lovely reflections.

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CLEMENT W. COUMBE.

SILVESTER, or **SYLVESTER**, the name of two popes and an antipope, as follows:

SILVESTER I, Saint. He succeeded Saint Melchiades in 314 and his pontificate lasted till 335. He presided through his delegate at the Council of Nice and is said to have held a council at Rome to condemn the errors or Arius and others. The story of his having baptized Constantine is pure fiction, as it is known that the latter was baptized by Eusebius at Nicomedia. Many churches were built or completed in his reign. During his pontificate the Arian heresy was at its height, against which Saint Athanasius was the great opponent. Consult Döllinger, ‘Church History.’

SILVESTER II (GERBERT): b. Aquitania; d. Rome, May 1003. At an early age he entered the monastery of Saint Gerard, in Aurillac, and after laying a foundation for all the sciences cultivated in that age he went to Spain to hear the Arabian doctors and was later appointed by Hugh Capet preceptor to his son, Robert. Otho III, emperor, who had also been his pupil, conferred upon him the archbishopric of Ravenna in 998; and on the death of Gregory V, in 999, procured his election to the papacy, when he took the name of Silvester. He was a great promoter of learning and a proficient in various branches of science himself, his scientific knowledge procuring for him the reputation of a magician. He composed a number of works, particularly on arithmetic and geometry; and with his own hands made a clock, a globe and an astrolabe. Several of his letters on various subjects were printed at Paris in 1611; but the most complete collection has been given by Du Chesne. He was the first Frenchman to ascend the papal chair. Consult the collected edition of his works edited by A. Olleris (Clermont 1867).

SILVESTRE, sĕl'vĕs'tr', **Paul Armand,** French author: b. Paris, 11 April 1837; d. Toulouse, 19 Feb. 1901. He studied at the Ecole Polytechnique and in 1870 entered government service in the department of finance, in which he became deputy chief of the bureau. In 1892 he was appointed inspector of fine arts. He became well known as a poet of the Parnassian School, was an art critic and dramatist of ability; and, in contrast to his other work, a contributor of somewhat licentious tales to *Gil Blas* and other publications of that order. Author of (verse) ‘Rimes Neuves et vieilles’ (1866); ‘Les Renaissances’ (1870); ‘La Chanson ses heures’ (1878); ‘Le Chemin des etoiles’ (1885); (tales) ‘La Vie pour rire’ (1881–83); ‘Gauloiseries Nouvelles’ (1888); (dramas) ‘Sappho’ (1881); ‘Henry VIII’ (1883); (art criticism) ‘Le Nu au Salon’ (5 vols., 1888–92), etc.

SILYBUM, a genus of composite plants, the best-known species being the holy thistle or lady's milk. *S. marianum* is a tall plant with large spreading prickly leaves; those near the base are pinnatifid, and spotted with white, stained, according to legend, by drops of the Virgin's milk. It was formerly cultivated in English gardens, not only for ornament, but also for its edible roots, leaves and large, purple heads, surrounded by spiny involucre. It has become naturalized in some parts of eastern North America.

SIMANCAS, sē-män'käs, Spain, seven miles southwest of Valladolid, on the Pisuerga, is an old walled town. The ancient castle was converted into a record hall, where the archives of the kingdom have been preserved since the reign of Philip II (1563). They comprise 30,000,000 state and private documents, and occupy 46 rooms. The town contains a Roman bridge and the remains of Roman fortifications. It has large interests in cereal, fruit and viticulture in the neighborhood. Pop. 11,000.

SIMBIRSK, sĭm-bĕrsk', Russia, (1) capital of a government of that name, on the Volga, 576 miles by rail southeast of Moscow, is a well-built town. The chief buildings occupy an eminence overlooking the river; the business portion is lower down, and still farther are the quarters of the poor. There are two Greek cathedrals, gymnasia for children of both sexes, several other mixed schools, a sanatorium, two public libraries, a good theatre and many flourishing benevolent institutions. There is a public garden on Vyenets Hill, and numerous private gardens. Fruits are cultivated and exported. Fishing is one of the chief occupations. Trade in corn, potash, wool, fruits, woodenware and manufactured goods is considerable. As usual in Russian towns, an enormous business is transacted at the annual fair. Karamzin was born here. Pop. 64,000. (2) The government of Simbirsk contains an area of 19,110 square miles. Its vast plain is watered by the Volga, and is fertile. The higher portions are at the east. The west is traversed by numerous rivers, and the Sura is the principal stream in this section. Its tributaries are not navigable. The forests of the government are quite extensive; there are broad pastures, much arable land, a few lakes and marshes. The climate is very severe, great extremes being the rule. The chief crops are cereals, flax, hemp, tobacco and hay. Fish are abundant. Sulphur, iron ore, salt, ocre, asphalt and building stones are quarried. All kinds of woodenware are made, besides felt goods, nets, ropes, gloves, caps and handkerchiefs. The larger manufactories include woolen mills, tanneries, glass and starch works, wagon and carriage works and flour mills. The value of industrial output in normal years is over $5,000,000. The exports are grains. Pop. 1,997,400.

SIMCOE, sĭm'kō, **John Graves**, first governor of Upper Canada: b. Cotterstock, Northamptonshire, England, 25 Feb. 1752; d. Torbay, Devonshire, 26 Oct. 1806. He was educated at Eton and Oxford, and in 1771 entered the army as ensign. He fought throughout the war against the American colonies, and was made a colonel in 1781. Returning to England after Cornwallis' surrender, he entered Parliament in 1790 as member for Saint Mawe's, Cornwall; and in 1791, on the division of the Canadas, became the first lieutenant-governor of Upper Canada. He established his capital at Newark (now Niagara) on 8 July 1792 and began his administration with a legislature of seven members. He encouraged the Loyalists from the independent States to settle in the new country and devoted himself to its agricultural development and military defense. In 1793 he set about removing the seat of government from Newark to Toronto, which capital he practically founded. In 1794 he was appointed commandant of Santo Domingo; but returned to England in 1797, where he was promoted lieutenant-general. In 1806 he was appointed commander-in-chief in India. but was taken ill on the voyage out and obliged to return. Consult Scott, D. C., 'John Graves Simcoe' (Toronto 1905).

SIMCOE, Canada, town and county-seat of Norfolk County, Ontario, 40 miles southwest of Hamilton, and eight miles north of Lake Erie, on the Grand Trunk and the Wabash railroads. There are manufactures of woolen goods and of "warping tugs," the land-and-water boats used in the Canadian lumber industry. Pop. 3,227.

SIMCOE, Lake, Ontario, Canada, a lake situated about midway between Georgian Bay and Lake Ontario. It is about 30 miles long and 18 miles wide, and contains several islands. The banks are densely wooded, and good whitefish are found in its waters. It discharges into Georgian Bay through the Severn River. Barrie and Orillia, connected with the Canadian railway system, are the chief towns on its shores. Its shores witnessed the war of extermination between the Huron and Iroquois.

SIMEON, sĭm'ę-ŏn, the second son of Jacob and Leah, and ancestor of one of the Twelve Tribes of Israel, which dwelt to the north of the tribe of Judah. When Simeon and his brethren went into Egypt to buy corn, his brother, Joseph, then chief minister of Egypt, but not yet known to his brethren, insisted on Benjamin, the youngest brother, being brought to him, and detained Simeon as a hostage for his forthcoming. Consult Graf, 'Der Stamm Simeon' (Meissen 1866); Meyer, Edward, 'Die Israeliten' (Halle 1906) and Steuernagel, 'Einwanderung der israelitischen Stämme' (Berlin 1901).

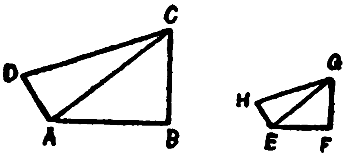
SIMEON STYLITES, stī-lī'tēz. See PILLAR SAINTS.

SIMETO, sē-mä'tō, or **GIARETTA**, jä-rĕt'tä, the largest river of Sicily. It flows west and south of Mount Etna into the Gulf of Catania, is 93 miles long, but unnavigable.

SIMFEROPOL, sĭm-fĕr-ŏ'poly', Russia, capital of the government of Taurida, in the Crimea, on an elevated plain at the foot of lofty hills 40 miles northeast of Sebastopol. It consists of an old and a new town — the former poorly built, and occupied chiefly by Tatars, the latter with a handsome square and regular, spacious streets, and has several churches and mosques, a gymnasium and a large civil and military hospital. Under the Tatars it was known as Ak-mechet; in 1736 the Russians captured and burned it. When the Crimea fell to Russia in 1784 the town received its present name. Pop. 69,666.

SIMIIDÆ, the family which embraces the anthropoid apes. See APE and the names of the animals there referred.

SIMILARITY. In geometry similar figures are those which are mutually angular and have their homologous sides proportional. The homologous sides are those which are adjacent to the equal angles. Thus the figures ABCD, EFGH are similar if the angle A equals angle E; angle B equals F, angle C equals G, etc., and



$\frac{AB}{EF}$ equals $\frac{BC}{FG}$ which equals $\frac{CD}{GH}$ which equals $\frac{DA}{HE}$.

The constant ratio of any two homologous sides of similar figures is called the *ratio of similitude* of the figures. Triangles which are mutually equiangular are similar. Two triangles are similar when two angles of the one are equal respectively to two angles of the other; therefore, a triangle is similar to any triangle cut off by a line parallel to one of its sides. Triangles which have their homologous sides proportional are similar. Two triangles which have an angle of the one equal to an angle of the other, and the sides about these angles proportional, are similar. Two triangles which have their sides parallel or perpendicular, each to each, are similar. If two polygons are composed of the same number of triangles, similar each to each and similarly placed, the polygons are similar. In solid geometry, similar polyhedrons are those whose corresponding polyhedral angles are equal, and which have the same number of faces, similar each to each, and similarly placed. Any two homologous tetrahedrons are similar. Two similar tetrahedrons are to each other as the cubes of their homologous edges, and two similar polyhedrons are to each other as the cubes of their homologous edges; therefore, similar prisms, or pyramids, are to each other as the cubes of their altitudes and similar polyhedrons are to each other as the cubes of any two homologous lines. Similar cylinders of revolution are those generated by similar rectangles revolving round homologous sides. The lateral areas, and the total areas, of two similar cylinders of revolution are to each other as the squares of their altitudes, or as the squares of the radii of their bases. The volumes of similar cylinders of revolution are to each other as the cubes of their altitudes, or as the cubes of their radii. Similar cones of revolution are those generated by similar right triangles revolving round homologous perpendicular sides. The lateral areas, or the total areas, of two similar cones of revolution are to each other as the squares of their radii, or of their slant heights, or of their altitudes, and the volumes of similar cones of revolution are to each other as the cubes of their altitudes, or as the cubes of the radii of their bases.

SIMILE, a common figure of speech, in which two things which have some strong point or points of resemblance are compared. It differs from metaphor by reason that the resemblance between object and image is stated expressly by means of the words *like* or *as,* whereas in the metaphor the resemblance is assumed. Among the most famous similes of masters of literature are «About as much privacy as a goldfish» (Irvin S. Cobb); «Winter, like a cold, unapproachable beauty, retains her character until the lawful season of thaw has arrived» (Goncharon); «Hard as a barren stepmothers' slap» (Lady Gregory); «Distant as the dead» (Schiller); «Tedious as a twice told tale» (Homer); «Fleeting as the wings of sleep» (Virgil); «Black as a crow» (Chaucer); «Hooted at like an old tale» (Shakespeare); «You look at a star from two motives, because it is luminous and because it is impenetrable. You have at your side a softer radiance and a greater mystery — woman» (VictorHugo). Consult Wilstach Frank J., ‹Dictionary of Similes› (6th ed., 1916).

SIMKHOVITCH, sĭm-kō'vĭch, **Mary Melinda Kingsbury,** American social economist, wife of V. G. Simkhovitch (q.v.): b. Chestnut Hill, Mass., 8 Sept. 1867. She was graduated at Boston University in 1890 and later studied at Radcliffe College and at the universities of Berlin and Columbia. She was married to Dr. Simkhovitch in 1899. She was head worker at the College Settlement, New York, in 1898; at the Friendly Aid House in 1898–1902, and since 1902 has been at Greenwich Village House, New York. In 1907–10 she was adjunct professor at Barnard College, and she was associate in social economy at Teacher's College, Columbia University, in 1910–13. Since 1912 she has lectured at the New York School of Philanthropy.

SIMKHOVITCH, Vladimir Gregorievitch, American economist: b. Russia, 1874. He was educated at the universities of Petrograd, Berlin and Halle, taking his Ph.D. at Halle in 1898. He has been professor of economics at Columbia University since 1904. He is a trustee of Greenwich Village House and is author of numerous articles on economics in English, German and Russian, and of ‹Marxism Versus Socialism› (1913).

SIMLA, India, the chief town of a district of the same name in the Punjab, the most important of the hill-resorts and the summer capital of the Indian government, about 98 miles north-northeast of Ambala, 7,156 feet above the sea and since 1903 connected by a mountain railway with the Peninsular Railway system. Simla is situated on a series of wooded hill ridges, covered with deodars, rhododendrons and an innumerable variety of ferns; commands a magnificent prospect of the Himalayas, and has an equable temperature that rarely exceeds 70°. The governor-general and the commander-in-chief annually remove hither with their entire staff from Delhi, and go into residence for six months. All the environs are dotted with picturesque villas, and there are churches, schools, hotels, clubs, banks, etc. The chief schools are the Roman Catholic Orphanage for the children of soldiers, on the model of the Lawrence asylums; the Mayo industrial schools for the orphans of poor civilians; Bishop Cotton's School and the Punjab Girl's School, both for the higher education of the children of well-to-do Europeans. The district of Simla which is entirely surrounded by petty native states, has an area of 18 square miles, of which only about 12 are cultivated. The crops are wheat, Indian corn, ginger and poppy. Efforts are being made to grow hops, tea and cinchona. The neighboring mountains yield lead, iron and slate. This tract of hill country was acquired by the British in 1816, as a result of the Gurkha War and has since been augmented by purchase, lapse and exchange. The first house was built in 1819; Lord W. Bentinck was the first governor-general to select it as his summer quarters. Pop., town, 15,000 (winter), 35,000 (summer): district, 50,000.

SIMMONS, Duane, American physician and missionary: b. Glens Falls, N. Y., 1834; d. 1899. He studied medicine privately and went to Japan as a missionary in 1859, but subsequently entered the Japanese government service. He secured leave of absence in 1862–63 and studied medicine at Berlin, and later did much to improve public health in Japan. He founded the Juzen Hospital in 1869 and established a school for Japanese medical students. Reasons connected with his health caused him to return to the United States in 1881, but after 1887 he lived in Japan and devoted himself to the study of Japanese history. His writings on the subject are included in ‹Transactions of the Asiatic Society of Japan› (Vol. XIX, 1892).

SIMMONS, Edward Emerson, American painter: b. Concord, Mass., 1852. He was graduated from Harvard in 1874 and studied art in Paris. Since 1892 he has followed decorative painting. Among the public buildings containing his work are the Boston State Capitol, Saint Paul State Capitol, Pierre State Capitol, Criminal Court, New York, Appellate Court, New York, Panama-Pacific Exposition, San Francisco, Library of Congress, Hotel Astoria, New York. He has also decorated the dwellings of J. D. Rockefeller and F. Vanderbilt.

SIMMONS, Franklin, American sculptor: b. Webster, Me., 11 Jan. 1839; d. 1913. He first came into notice in 1865–66, when, at Washington, D. C., he produced several bronze medallions of members of the Cabinet and famous army and navy officers, including Farragut, Porter, Grant, Meade, Sheridan, Sherman, etc. In 1868 he went to Rome, Italy, where he resided for many years. In 1898 he was knighted by the king of Italy. He executed about 100 portrait busts in marble, and about 15 public monuments, including statues of General Grant, William King and Roger Williams in the National Capitol, Longfellow and Soldiers' monuments at Portland, Me., and numerous ideal statues, among which are Penelope, Medusa, Seraph Abdiel, Galatea, etc. The Metropolitan Museum of Art contains his ‹Promised Land.›

SIMMONS, Furnifold McLendel, American lawyer and statesman: b. Jones County, N. C., 20 Jan. 1854. He was graduated at Trinity College, North Carolina, in 1873, was admitted to the bar in 1875 and afterward practised at New Bern and at Raleigh. He served in Congress in 1887–89; was collector of internal revenue in North Carolina in 1892–97, and for many years was chairman of the Democratic Executive Committee of North Carolina. Since 1901 he has served continuously in the United States Senate and in 1918 was re-elected for the term 1919–25. He was prominent in the struggle for a partial disfranchisement of the Negroes in North Carolina, and was one of the framers of the Underwood-Simmons Tariff Act.

SIMMONS COLLEGE, located at Boston, Mass. It was founded in accordance with the will of John Simmons, for the purpose of providing education for women in such branches as will enable them to earn their livelihood. It was chartered in 1899 and opened in 1902. The departments of study include household economics, secretarial course, library course, science courses (including general science, preparing for teaching and medical preparatory), horticulture and courses in preparation for nursing. The last two were added to the curriculum in the year 1903–04. The full courses are four years in length, but college graduates and others who have had the academic work can complete the technical courses in one or two years. The course in commercial horticulture can be completed in three years, but a full course of four years is also provided; by arrangement with the Massachusetts Agricultural College at Amherst, Mass., only the work of the first two years of the horticultural course is done at Simmons College; the third or the third and fourth years' work is provided for at the Agricultural College. Besides the four years' course in preparation for nursing there is a one year's course, especially intended for those who have had college work and also a short summer course. Students are allowed to take single studies from the curriculum from any department, provided they are qualified for admission to the college and fitted to take up that particular study. Each department, however, leads to a definite practical occupation. There are also evening classes in shorthand, typewriting, languages, English, cookery, etc.; the evening work is not correlated in the same manner as the day work, and is mostly taken by persons occupied during the day who wish to improve themselves in studies relating to their occupations. By an arrangement made with the Boston Cooking School, the property and management of that school was transferred to Simmons College, the cooking school being represented by a board of visitors. In accordance with this agreement the college offers a special one-year course in cookery in place of the former normal course of the cooking school, and private practice lessons. The funds of the cooking school become a permanent fund for two scholarships. The college plant comprises Simmons Hall on the Fenway, School for Social Workers, Somerset Street, and eight dormitories. The property of the institution is valued at $3,150,000, about 66 per cent of which is an endowment fund. The students, in 1918, numbered 1,046; the faculty numbered 121; and the library contained 26,431 volumes.

SIMMONS COLLEGE, Texas, a coeducational institution, founded at Abilene in 1891, under Baptist control. It gives the degree A.B., and its courses include industrial and manual arts and sciences, and agriculture and stock-raising. It has an endowment fund of about $100,000 and its buildings and equipment are valued at about $200,000. In 1919 it has 1,035 students, 10 students with the colors and 125 instructors.

SIMMS, sĭmz, **William Gilmore,** American novelist: b. Charleston, S. C., 17 April 1806; d. there, 11 June 1870. He received a secondary education at Charleston, was a clerk in a chemical house, but turned first to the law, then to literature, published a volume of ‹Lyrical and Other Poems› (1827), and in 1829 became editor and a part owner of the *Charleston City Gazette,* which failing in 1833 carried with it his fortune, and necessitated a busy pen. A few of his poems have clung to the anthologies, but he is best known for his works of fiction. Rarely he ventured, and always with failure, to past times and strange lands; but when he laid his scenes in the South and Southwest he was convincing and vigorous; in the Georgia gold fields, in the southern battle-fields of the Revolution, in forest and bayou he conducted bold adventures, described in a manner suggestive of Cooper, though failing in Cooper's constructive skill. ‹The Yemassee,› a story of colonial South Carolina, is generally ranked as his best. Before the Civil War he had attained a very considerable reputation, being somewhat read even in Britain and Europe. After the war he found himself out of vogue. He was at one time editor of the *Southern Quarterly Review.* Others of his volumes are ‹Martin Faber› (1832); ‹Atalantis› (1832), a poem; ‹Castle Dismal› (1845); ‹Guy Rivers› (1834); ‹Richard Hurdis› (1838); ‹Border Beagles›

(1840); 'Beauchamp' (1842); 'The Wigwam and the Cabin,' short stories (1846); 'The Partisan' (1835); 'The Maroon' (1855); 'Eutaw' (1856); 'The Cassique of Kiawah' (1860). (See YEMASSEE). Consult Trent, William P., 'William Gilmore Simms' (Boston 1892); Sally, A. S., Jr., 'Life of William Gilmore Simms'; and Wegelin, O., 'List of the Separate Writings of W. G. Simms' (New York 1906).

SIMNEL, Lambert, English impostor and pretender to the throne: b. Oxford, about 1472; d. about 1534. While a boy he was trained by a priest, one Richard Symonds, to personate the claims of the York faction early in the reign of Henry VII. In 1487 he gave himself out as Edward, earl of Warwick, son of Clarence, and sole heir of the house of York. He was crowned at Dublin as Edward VI. Supported by troops furnished by malcontent nobles he landed in England, but was defeated a few days later at Stoke. Henry imprisoned Symonds for life, but gave Simnel a place in the scullery and afterward made him falconer. Consult Bush, W., 'England Under the Tudors' (London 1895); Gairdner, James, 'Henry VII' (ib. 1889); Vergil, Polydore, 'Anglicæ Historiæ,' the most reliable contemporary account.

SIMOIS, sĭm'ō-ĭs, or **DUMBREK SU,** Asia Minor, a river rising in the Kaz Dagh-Ida and emptying into the Scamander or Xanthus, now supposed to be identical with the Menderé. Ancient Troy was partly built upon its banks, and the peak of Samothrace towers above it. It bordered the battle fields of the Trojan War, sung by Homer and other Grecian poets.

SIMON, Joseph, American pioneer: b. 1712; d. Lancaster, Pa., 24 Jan. 1904. Emigrating to Lancaster about 1740, he engaged in the Indian trade, soon becoming prominent in that line and one of the largest landholders in Pennsylvania, his enterprises extending to the Mississippi, while he had an interest in business in the Indian Territory. He supplied the Continental army with rifles, ammunition, drums, blankets and other supplies. A deed given to him and 11 traders 8 Nov. 1768, still preserved in Independence Hall, Philadelphia, records the Treaty of Fort Stanwix, whereby a tract of land comprising the present State of West Virginia was granted to them by all the tribes of the Six Nations. The grant never passed into the hands of the purchasers, owing to Virginia's resistance and the breaking out of the Revolution. Consult Ellis and Evans, 'History of Lancaster County'; Markens, 'The Hebrews in America' (pp. 78–82); 'Publications of the American Historical Society' (Vol. I, pp. 120–122; Vol. IX, pp. 31–32).

SIMON, Joseph, American politician: b. Germany, 1851. He was brought to this country in infancy, and since 1857 has been a resident of Portland, Ore. Admitted to the bar in 1872, he was elected to the city council in 1877, serving for three years. In 1878 he managed the State campaign for the Republicans, and was chairman of the State central committee in 1880, 1884 and 1886. He was State senator 1880–98, and was elected president of the State senate in 1889, 1891, 1895, 1897 and 1898. He sat in the United States Senate 1898–1903.

SIMON, sē-môṅ, **Jules (Jules François Simon Suisse),** French philosopher and statesman: b. Lorient, department of Morbihan, 27 Dec. 1814; d. Paris, 8 June 1896. He was educated at the college of his native town, at Vannes, and in the École Normale, Paris. In 1839 he succeeded Cousin as professor of philosophy in the Sorbonne, but lost this post in 1851 by refusing to take the oath of allegiance to Napoleon III. He was returned to the Constituent Assembly by the department of Côtes-du-Nord in 1848. In 1855–56 he delivered a series of philosophical lectures in several towns of Belgium, and in 1863 he was returned to the Chamber of Deputies for a division of the department of the Seine. He strongly opposed the war with Prussia, and after the revolution of 1870 became a member of the provisional government, and was Minister of Education under Thiers from 1871 to 1873. In 1875 he was elected to the Senate, and member of the Academy. In 1876 he became leader of the Republicans, and was Minister of the Interior and Premier until 16 May 1877, when he was dismissed by MacMahon. He was a consistent advocate of free trade and of liberal principles, and opposed M. Ferry's bill of 1879 for suppressing non-authorized religious bodies. In 1882 he was elected permanent secretary of the Academy of Moral and Political Sciences. He edited various journals, including the *Siècle* and the *Echo Universel*. His chief works include 'Histoire de l'ecole d'Alexandrie' (2 vols., 1844–45); 'Le Devoir' (1854); 'La liberté de conscience' (1857); 'L'Ouvrière' (1863); 'L'Ecole' (1864); 'Le travail' (1866); 'La politique radicale' (1868); 'La peine de mort' (1869); 'Souvenirs du 4 Septembre' (1874); 'Le gouvernement de M. Thiers' (1878); 'Le livre du Petit Citoyen' (1880); 'Victor Cousin' (1887); 'La femme du XXe Siècle' (1891); 'Quartre portraits: Lamartine le cardinal Lavigerie Renan, L'Empereur Guillaume II' (1896); 'Premiers mémoires' (1900); 'Le soir de ma journée' (1902), etc. He also produced excellent editions of the writings of several great French philosophers, including Descartes and Malebranche. Consult Picot, G., 'Jules Simon: notice historique' (1897); Séché, Léon, 'Figures bretonnes, Jules Simon, sa vie, son œuvre' (new ed., 1898) and Thieme, Hugo P., 'Guide bibliographique de la litterature francaise de 1800 à 1906' (Paris 1907).

SIMON, Richard, Roman Catholic theologian and scholar: b. Dieppe, 13 May 1638; d. there, 11 April 1712. He was member of the Oratory in Paris, but soon abandoning the order he spent his life as parish priest in his native town and the publication from time to time of his works alone interrupted the uneventfulness of his career. Yet he must be looked upon as the father of modern Biblical science and he went far beyond the authority of Church tradition in handling the origin, authenticity, and interpretation of the Hebrew and Greek Scriptures. Many of his conclusions aroused much bitter controversy in his day and met with the approval of neither the Roman Catholic nor Protestant reader. Although at one time an object of suspicion by the Church authorities, Simon remained a faithful Catholic and died in the Church. His principal publications were 'Histoire critique du Vieux Testament' (1678); 'Histoire critique du Nouveau Testament'

(1693); 'Histoire critique des principaux commentateurs du Nouveau Testament' (1693); 'Nouvelles Observations sur la texte et les versions du Nouveau Testament' (1695). Consult Bernus, 'Richard Simon et son histoire critique du Vieux Testament' (1869); id., 'Notice bibliographique sur Richard Simon' (1882); Cheyne, T. K., 'The Founders of Old Testament Criticism' (New York 1893); Duff, Archibald, 'History of Old Testament Criticism' (ib. 1910).

SIMON MACCABÆUS, sī'mŏn măk'ă-bē'ŭs, Jewish prince and high priest: d. 135 B.C. He was the second of the five sons of the high priest Mattathias, all of whom became famous in their struggle to free the Jews from Syrian domination. When dying Mattathias exhorted his sons to heed the advice of Simon whose abilities he highly regarded. Simon took an important share in the war for liberation pressed against the Syrians by Judah and Jonathan, and after the death of Judah and the capture of Jonathan he was elected leader. He completed the fortification of Jerusalem, expelled all the Gentiles from Joppa, and after preventing Trypho from entering the country to seize the throne of Syria he sent a deputation to Demetrius II requesting freedom from taxation for Judea. Compliance with this request carried with it recognition of the political independence of the country and the Jews established a new era, dating by the years of Simon. The leadership was made hereditary in his family, thus founding the Hasmonæan dynasty, and a new mintage of coins was begun. Simon strengthened his position by the capture of the city of Gazara, from which he expelled the pagan population, and in 142 B.C. he subdued the garrison at Akra. His reign lasted seven years and was remarkable for its peace and prosperity. He secured the friendship of Rome and the respect and esteem of other foreign powers, and by his own people was made high priest as well as ruler in 141 B.C. In 136 B.C. the country became again involved in war with Syria, and Simon entrusted the command of his armies to his sons, Judah and John, who were victorious. In 135 B.C. Simon and his sons Judah and Mattathias were slain at a banquet given him by his son-in-law, Ptolemus; and his son, John Hyrcanus I, succeeded to the throne.

SIMON MAGUS, mā'jŭs, a magician, mentioned in the Acts of the Apostles: b. Sitton in Samaria. He professed to be an æon of an exalted nature, and called himself the supreme power of God. (See GNOSTICS). Struck with astonishment at the miracles of the apostles, and at the effect which followed the imposition of hands, he offered them a sum of money to be endued with similar powers. His proposal met with an indignant refusal on the part of Peter; and from the fact of Simon Magus being the first person who attempted to traffic with money in spiritual functions and endowments, the term simony has been employed to designate such traffic. (See SIMONY). After this Simon traveled through the empire making proselytes, taking as his companion a Tyrian courtesan, whom he represented as Helen of Troy, and sometimes as Minerva, calling her at the same time the first intelligence, or mother of all things. Consult Hastings, 'Dictionary of the Bible' (New York 1902); Schmiedel, P. W. (in 'Encyclopædia Biblica,' ib. 1903) and Waitz, H. (in 'Real-encyklopädie für Theologie und Kirche' (Vol. XVII, Leipzig 1906).

SIMONDS, sī'mŏndz, **Frank Herbert**, American journalist and author: b. Concord, Mass., 1878. He was graduated at Harvard University in 1900, having interrupted his university course to serve in the war with Spain in 1898. He was Albany correspondent of the New York *Tribune* in 1903–05; and of the New York *Sun* in 1905–08. He returned to New York as a member of the editorial staff of the *Sun* in 1908 and became known as a forceful writer on foreign and domestic politics, his articles on the Moroccan crisis and on the Balkan War firmly establishing his reputation. He became editor of the New York *Evening Sun* in 1913, and in 1915 transferred his services to the New York *Tribune* as associate editor in charge of its editorial page. His articles on the European War appeared in part in the *American Monthly Review of Reviews*. Author of 'The Great War — the First Phase' (1914); 'The Great War — the Second Phase' (1915); 'They Shall Not Pass' (1916); 'Three Years of the Great War' (1917); 'History of the Great War' (Vol. I, 1917), etc.

SIMONDS, Frederic William, American geologist: b. Charlestown, Mass., 3 July 1853. He was graduated at Cornell University in 1875, and was instructor in geology and palæontology there 1875–77. He was professor of geology, zoology and botany at the University of North Carolina 1877–81, and of geology and biology at the University of Arkansas 1887–90. Since 1895 he has been professor of geology at the University of Texas. He is a Fellow of the American Association for the Advancement of Science, the Geological Society of America and of the Texas Academy of Science. He has published the 'Annual Report of the Geological Survey of Arkansas' (1891); 'A Record of the Geology of Texas' for the decade ending 31 Dec. 1896 (1900); 'The Minerals and Mineral Localities of Texas' (1902); 'The Geography of Texas — Physical and Political' (1905); 'The Maury-Simonds Physical Geography' (1908), and numerous papers in scientific journals.

SIMONIDES, sī-mŏn'ĭ-dēz, Greek lyric poet: b. Island of Ceos, 556; d. about 468 B.C. Invited by Hipparchus, tyrant of Athens, to visit that city, he there met Anacreon and Lasus, Pindar's master. After the death of Hipparchus he proceeded to Thessaly, where he won the favor of the Aleuads and Scopads, whose victories in the games he afterward celebrated. Returning to Athens, in a competition for the best elegy upon those who fell on the field of Marathon, he gained the prize over Æschylus himself. Shortly after this he was invited to the court of Hiero at Syracuse, where he remained till his death at the age of 90. He appears to have been a chief favorite with Hiero in a court adorned by the presence, among others, of Pindar, Bacchylides and Æschylus. Poetic conception, pathos and perfect power of expression, in addition to the sweetness which procured for him the surname of Melicertes, are among the chief characteristics of his poetry, though in copiousness, vigor and originality he was surpassed by Pindar. He brought the elegy and epigram to a high degree of perfection, and in the dithyramb and triumphal ode he particularly distinguished himself. To Simonides belongs the unenviable fame of being the first who took money for his poems. The best editions of his works are Schneidewin's ‹Simonidis Cei Carminum Reliquiæ› (1835); and Bergk's (in his ‹Poetæ Lyrici Græci,› Leipzig 1843; 4th ed., 1882; reprint 1914); Smyth, H. W., ‹Greek Melic Poets› (London 1900). Consult Croiset, A. and M., ‹Abridged History of Greek Literature› (English trans., New York 1904); Christ-Schmid, ‹Geschichte der griechischen Litteratur› (Vol. I, 6th ed., Munich 1912), and Wright, W. C., ‹Short History of Greek Literature› (New York 1907).

SIMONOSEKI, sē-mō-nō-sĕk'ē. See SHIMONOSEKI.

SIMON'S TOWN, Cape Colony, South Africa, on the west coast of False Bay, about 22 miles from Cape Town, has a safe anchorage and is extensively fortified. There are a large arsenal, dock yards, naval hospitals and a high school. About $12,000,000 have been expended on the docks and dockyards. A railway connects it with the interior. Its position lends it considerable military and commercial importance. It has a salubrious climate. Pop. 7,246.

SIMONY (from ‹Simon Magus,› Acts viii), a transaction by which something sacred or spiritual is given, or received for a pecuniary compensation, or a temporal benefit. The nature of simony is clearly illustrated in the case of Simon Magus, when it was committed for the first time. Simon was a Samarian, noted for his skill in magic. Attracted by the miracles wrought by the preachers of Christianity, he adopted the new faith and was baptized by Philip. Later, Peter and John came to the East to minister to the new converts. «Then laid they their hands on them and they received the Holy Ghost.» When Simon saw this, he offered them money, saying: "Give me also this power.» But Peter said unto him: «Thy money perish with thee, because thou hast thought that the gift of God may be purchased with money.» Simony, later, assumed many forms, but it always implies an exchange of some material thing or temporal benefit for something spiritual, that concerns God, principally, as purchased office, or preferment in the Church. The degree of this affiliation as well as the disposition of those who are guilty of this sin account for its several modifications and fall to the province of theologians. The ecclesiastical penalties imposed for simony, according to its degree of perversity, are excommunication; reservation of absolution for the culprit to the Pope; suspension of clerics who are guilty of it; restitution of benefices due to it, and the like. In England, simony has been the subject of secular as well as ecclesiastical legislation, but in the United States it is not a civil offense and there is doubt if it even is an ecclesiastical offense, outside the Catholic and Episcopalian denominations. Consult Phillimore, Sir Walter, ‹Law of the Church of England› (2d ed., London 1895).

SIMOOM, sĭ-mōōm', **SIMOON**, or **SAMUN** (Arabic, *samma*, «hot» and «poisonous»), a noxious hot wind which blows at the period of the equinoxes in most countries bordering on sandy deserts, especially in certain parts of Asia and Africa, where its temperature has been known to reach as high as 130°. The intense and parching heat, resembling that of an oven, is derived from the hot sands, which, in the deserts of Africa and Arabia, often become heated for a depth of some inches to 200° F. This hot sand is whirled up from the earth by the advancing wind, and the whole air is filled with an extremely subtle and penetrating dust, the effect of which, if breathed freely, is to induce suffocation. The approach of the simoom is heralded by a thin haze along the horizon, which rapidly becomes more and more dense, till it covers the whole face of the heavens. This is followed by fierce gusts of wind, accompanied with clouds of red and burning sand, which are whirled round in rapid gyrations, and so swept onward. Sometimes whole caravans are buried in the masses of sand thus carried along. The simoom generally lasts from 6 to 12 hours and sometimes longer. When the wind blows in squalls death is often very suddenly produced by actual suffocation, and is followed by bleeding at the nose and mouth. Persons exposed to it protect themselves by stopping the mouth and nose with handkerchiefs, and the camels instinctively bury their noses in the sand at its approach. The effects of the simoom are felt in the south of Europe, the hot wind produced in Italy being called the sirocco. In Turkey this wind is called the «*samieli*»; in Guinea and Senegambia a similar wind is called «*harmattan*.» Winds of similar origin and nature exist in Australia and parts of North and South America. In the southeast of Spain a similar wind is known as the solano; while the krusin, which generally last for 50 days to two months, blows from the northeast across Egypt. See HARMATTAN; SIROCCO and SOLANO.

SIMPLE STORY, A, the best known of the works of Mrs. Elizabeth (Simpson) Inchbald, was published in 1791 and was a very successful novel. Written somewhat in the stately style of the 18th century and dwelling considerably on character and grand manners, it is none the less a touching and in many respects a moving story. Derriforth, a scholar in Catholic orders and later Lord Elmsford, marries his ward, Miss Milner, after a courtship marked by high breeding, misunderstandings, capriciousness and all but irreconcilable strains of temper. After a happy married life of some years, Lady Elmsford, during the prolonged absence of her husband, elopes with a former lover. Lord Elmsford, a man of stern resolution, vows never to see or hear of his wife or their daughter, Mathilda, again. On the early death of Lady Elmsford, the story resolves itself into a tale of the reconciliation of father and daughter through a long period of years, and the final happy settlement of all troubles. The main characters that have been mentioned and those of Miss Woodley and Mr. Sandford, the chaplain, are well conceived and firmly executed. The novel with its strongly emotional cast, is sometimes regarded as the antecedent of that kind of story of which Charlotte Brontë's ‹Jane Eyre› is the most famous English representative.

WILLIAM T. BREWSTER.

SIMPLICIDENTATA, one of the two divisions of the order of rodents (*Rodentia*), embracing those with only a single pair of upper incisors. It includes all of the rodents except the pikas, rabbits and hares, which are duplicidentate. See Leporidæ; Rodentia.

SIMPLICISSIMUS, a German novel, fully titled as 'Der abenteuerliche Simplicissimus, Teutsch, das ist; Aie Beschreibung des Lebens eines seltsamen vaganten, genannt Melchoir Sternfels von Fuchsheim' (1668), by Hans Jakol Kristoffel von Grimmelshausen (q.v.), and regarded as the forerunner of modern German novel. 'The adventurous German, Simplicissimus, that is: A Description of the Life of a Remarkable Vagabond named Melchior Sternfels, of Fuchsaim,' as the translated title reads, is a vivid and realistic story of the Thirty Years' War.

SIMPLICIUS, sĭm-plĭsh'ĭ-us, a peripatetic philosopher: b. in Cilicia. He was a pupil of Ammonius and Damascius, and taught in Alexandria and Athens during the reign of Justinian. In consequence of the persecutions these philosophers suffered from the decrees of the Christian emperor, seven of them, among whom was Simplicius, sought protection in the court of King Chosroes of Persia. Disappointed in their expectations in the East, they resolved to return, and the Persian king made it one of the articles of a treaty of peace with Justinian, that these philosophers should be exempted from the disqualifications imposed upon all pagans. Among the works of Simplicius are commentaries on Aristotle's 'Categoriæ Physicæ,' 'De Cœlo,' and 'De Anima,' and also one on the 'Enchiridion' of Epictetus. Consult the edition of his works by Schweighäuser (Leipzig 1800); edition of his commentaries on Aristotle's works by Karsten (1865) and Enk's edition of the 'Enchiridion' (Vienna 1866).

SIMPLIFIED SPELLING. See Spelling Reform.

SIMPLON, sĭm'plŏn, Fr. săṅ-plôṅ (Ital. Sempione, sĕm-pē-ō'nē), Switzerland, a mountain of the Lepontine Alps, 11,117 feet high, in the east of the canton of Valais. The road that passes over it was regarded as one of the most celebrated engineering works of the early part of the 19th century, but is decreasing in importance since the advent of railroads, and the construction of the Simplon tunnel, affording direct communication between Switzerland, France and Italy. The road commences near Brieg on the Swiss side, and terminates at Domodossola in Piedmont. It was begun in 1800 under the direction of Napoleon, and was completed in 1806. It is 38 miles long, from 25 to 30 feet wide, is carried across 611 bridges, and through a number of great tunnels, rises to the height of 6,578 feet, and has 20 station houses for travelers. The railway tunnel through the mountain from Brieg on the Swiss side to Iselle on the Italian side was commenced in 1898, and the contract called for its completion in five and one-half years, for $13,413,500. Work upon it was completed in 1906. It is 20 kilometres, 12.4 miles, in length, the longest tunnel in the world, and the third, with Mont Cenis and Mont Gotthard, connect Italy by rail with the adjacent countries. See Tunnels.

SIMPLON TUNNEL, The, an important work of engineering through the Lepontine Alps, designed to afford a better means of communication between France and Italy. It was commenced in 1898, completed in eight years, and is 12½ miles in length. See Tunnels, and consult 'La ferrovia del Sempione' (Rome 1900).

SIMPSON, Edward, American naval officer: b. New York, 3 March 1824; d. Washington, D. C., 1 Dec. 1888. He was appointed midshipman in the navy in 1840, was graduated from Annapolis in 1846 and served in the Mexican war on the steamer *Vixen*. In 1858–62 he was in charge of the department of naval gunnery at the Naval Academy, commandant of midshipmen in 1862–63 and commanded the monitor *Passaic* in 1863–64, participating in several engagements. He was commissioned commander in 1865; served as fleet-captain of the consolidated Gulf squadron; was present at the fall of Mobile, and received the surrender of the Confederate fleet on Tombigbee River. He became captain in 1870, commodore in 1878 and rear-admiral in 1884. He was retired in 1886, but was president of the United States Naval Institute in 1886–88. He published: 'Ordnance and Naval Gunnery' (1862); 'The Naval Mission to Europe' (2 vols., 1873); 'Report of the Gun Foundry Board' (1885); 'Modern Ships of War' (1887); etc.

SIMPSON, Sir George, Scottish traveler: b. Loch Broom, Ross-shire, about 1796; d. Lachine, near Montreal, P. Q., 7 Sept. 1860. In 1809–20 he was employed by a London firm in the West India trade, where his ability attracted the attention of the Earl of Selkirk, then head of the Hudson Bay Company, and in 1820 he was appointed to conduct the affairs of the company in America. He united the Hudson Bay Company and the Northwest Company, and became successively governor of the Northern department, governor-in-chief of Rupert's Land and general superintendent of the affairs of the Hudson Bay Company. He planned the expedition of his cousin Thomas Simpson in 1836–39, greatly aided other explorers, and in 1841–42 made the overland journey around the world, claiming to be the first traveler to complete the journey. He was knighted in 1841. He published 'Narrative of an overland Journey Around the World During the Years 1841–2' (2 vols., 1847). Hopkins, J. C., 'Canada: An Encyclopædia' (Toronto 1898–1900) and Macdonald, A., 'Peace River: A Canoe Voyage from Hudson's Bay to the Pacific by Sir George Simpson (Ottawa 1872).

SIMPSON, Sir James Young, Scottish obstetrician and developer of anæsthesia: b. Bathgate, Linlithgow, 7 June 1811; d. Edinburgh, 6 May 1870. He entered Edinburgh University at 14 years of age and took his M.D. there in 1832. His brilliant graduation thesis won him the immediate appointment of assistant to Dr. John Thomson, professor of pathology at the University; and he also engaged in practice in Edinburgh, in which he was unusually successful. In 1839, when he was but 29, he was appointed professor of midwifery at the university. Of a keenly sympathetic temperament he was from the first deeply interested in the reports from America of the use of sulphuric ether as an anæsthetic and late in the year 1846 he witnessed an operation performed by Robert Lister in which the patient was rendered completely unconscious. Simpson soon afterward made the first trial of it in obstetric practice and upon its proving successful he continued its use and became its enthusiastic advocate. He believed, however, that an improved anæsthetic could be found and in 1847 he established the efficacy of chloroform in this respect, making the first public trial of it in November 1847 at the Edinburgh Infirmary. His advocacy of the use of anæsthetics in obstetric cases aroused from the first a storm of protest not only from the medical profession but on the part of the public and clergy as well. His triumph in its final adoption was materially hastened by the appointment conferred upon him by Queen Victoria in 1846 as her personal surgeon in Scotland and her subsequent treatment by him in childbirth. In 1856 he was awarded the Monthyon Prize of the French Academy of Sciences for his achievements in anæsthetics; he was made a member of practically all the European and American medical societies; and in 1866 he received a baronetcy, the first awarded a physician in Scotland. He made further notable achievements in gynecology, in which he was far in advance of his time. Much of his phenomenal success is credited to his ability to foresee possibilities, an evidence of which occurs in his graduation thesis, wherein he voiced the hope that in the future physicians might be able to inspect the entire body by the "concentration of electric and other lights," an advantage later given by the X-Ray. His family declined burial for him in Westminster Abbey, but a bust of him was placed there. A statue was erected in Edinburgh, but his chief monument is the Maternity and Simpson Memorial Hospital at Edinburgh. In the medical profession he ranks with Harvey, Jenner and Lister. Author of ‹Obstetric Memoirs and Contributions› (2 vols., 1855–56); ‹Selected Gynæcological Works› (1871); ‹Anæsthesia› (1871); Clinical Lectures on Diseases of Women› (1872); ‹Archæological Essays› (2 vols., 1873). A full list of his contributions to medical periodicals is in the index catalogue at the United States Army Surgeon-General's Office Washington, D. C. Consult Duns, J., ‹Memoirs› (1873).

SIMPSON, Matthew, American Methodist bishop and educator: b. Cadiz, Ohio, 21 June 1811; d. Philadelphia, Pa., 18 June 1884. He studied medicine and was admitted to its practice in 1833, but in 1834 closed his office and set out as a Methodist itinerant, filling 33 appointments in six weeks' tours. In 1835 he became pastor of the Liberty Street Church, of Pittsburgh, Pa., and in 1837 vice-president of Allegheny College (Meadville, Pa.), and professor there of natural science. He was elected, in 1839, first president of Indiana Asbury (the present De Pauw) University and undertook his work with three professors and 11 students in the four rooms of a hired building. After a successful administration, he resigned in 1858, and became editor of the *Western Christian Advocate,* official organ of his Church for the West. In this journal the editor took decided positions on slavery and other subjects of current discussion. He was elected bishop in 1852; and in 1857, when a delegate to the World's Evangelical Alliance at Berlin, preached in the Garnisonkirche, that being the first instance in which an established church in Prussia had been opened to an English-speaking Evangelical. During the Civil War he was a frequent adviser of President Lincoln. In 1881 he delivered the opening address at the Ecumenical Methodist Conference in London. He was best known for his eloquence, and published a volume of ‹Lectures on Preaching› (1879). In his own church he had also a considerable reputation as a parliamentarian and presiding officer. He further published ‹Hundred Years of Methodism› (1876); and ‹Cyclopædia of Methodism› (5th rev. ed. 1883). A posthumous collection of sermons was edited by George R. Crooks (1885). Of his orations among the best known is that at the funeral of Lincoln. A statue of him was placed in Philadelphia on the edge of Fairmount Park, 2 April 1902. Consult Crooks, George R., ‹Life of Bishop Matthew Simpson› (New York 1890).

SIMPSON COLLEGE, coeducational institution of higher education located at Indianola, Iowa. It was founded in 1867 by the Des Moines Conference of the Methodist Episcopal Church, from which it derives most of its support and patronage. Its organization includes seven departments: (1) college of liberal arts; (2) academy and normal courses; (3) the school of business; (4) the school of shorthand and typewriting; (5) the conservatory of music; (6) the school of oratory; (7) the school of art. A summer school is also maintained. The college department offers three courses, classical, philosophical and scientific, leading to the degrees of bachelor of arts, bachelor of philosophy and bachelor of science; these courses are all largely elective, the choice of the student being limited to a certain extent by the degree he wishes to obtain. Graduate work is provided for, leading to the degrees of master of arts, master of philosophy and master of science. Military drill and military science are a part of the curriculum, but are elective, except that drill is required for the men in the first two terms of the freshman year. The academic department offers three courses in preparation for the three college courses; there are two normal courses offered, one of three years, and one of five years, the work of the last two years of the latter course being almost entirely elective. The college is coeducational and there is a dormitory for women on the campus. The students of the different departments maintain a number of literary societies, all of which have their furnished halls. The college athletics are under the control of a joint committee, two members of which are appointed by the faculty, and three by the athletic association. The buildings include College Hall, Science Hall, Ladies' Hall, the administration building, the gymnasia and the Conservatory of Music (erected 1902); grounds and buildings in 1918 were valued at about $800,000; the library contained 11,000 volumes. The productive funds when last reported were $261,340; the annual income was $46,000. The students numbered 600 and the faculty 28.

SIMROCK, zĭm'rŏk, **Karl Joseph,** German poet: b. Bonn, Germany, 28 Aug. 1802; d. there, 18 July 1876. He studied at the university of his native city and at Berlin, and in 1826 entered the Prussian civil service, which he was later compelled to leave on account of a revolutionary poem which he had written. His chief claim to fame is founded on his classic modern rendering of the ‘Nibelungenlied’ (1827) which has gone through over half a hundred editions. He translated Shakespeare's poems and some of his plays, and published (with Echtermeyer and Henschel) ‘Quellen des Shakspere’ (1831). He also published ‘Handbuch der deutschen Mythologie’ (1853–55); ‘Deutsche Volksbücher’ (1839–67); ‘Heldenbuch’ (1843–49), illustrative of the heroic traditions of the Teutonic race and his own ‘Poems’ (1844). In 1850 he was appointed professor of old German language and literature at Bonn, a post which he held till his death. Consult Hocker, N., ‘Karl Simrock sein Leben und seine Werke’ (Leipzig 1877) and Schröder, E., (in ‘Allgemeine deutsche Biographie’).

SIMS, sĭmz, **George Robert**, English poet and dramatist: b. London, 2 Sept. 1847. He was educated at Hanwell College and at Bonn, and since 1874 has been engaged as a journalist and playwright. His publications include ‘Dragonet Ballads’ (1879); ‘How the Poor Live’ (1883); ‘Once Upon a Christmas Time’ (1898); ‘Living London’ (1902), etc. His plays include ‘The Lights of London’ (1882); ‘Two Little Vagabonds’; ‘In London Town’; ‘Scarlet Sin.’ Other works are ‘Social Kaleidoscope’; ‘Ten Commandments’; ‘Dorcas Dene, Detective’ (1897); ‘A Blind Marriage’; ‘The Cry of the Children’; ‘The Black Stain’; ‘Among My Autographs’; ‘For Life — and After’; ‘His Wife's Revenge’; ‘Anna of the Underworld.’ He is joint author of ‘Lights of London’; ‘Harbour Lights’; ‘Master and Man’; ‘Faust up to Date’; ‘Member for Slocum’; ‘Golden Ring’; ‘Little Christopher Columbus’; ‘Gray Mare’; ‘The Guardman’; ‘The Trumpet Call’; ‘The English Rose’; ‘Two Little Vagabonds’; ‘In Gray Piccadilly’; ‘The Elixir of Youth’; ‘Romany Rye’; ‘My Innocent Boy’; ‘Dandy Fifth’; ‘Gipsy Earl’; ‘Golden Ladder’; ‘Hop o' My Thumb’; ‘Sleeping Beauty’, ‘Puss in Boots’; ‘Ever Open Door,’ etc. Consult Archer, W., ‘English Dramatists of To-Day’ (London 1882).

SIMS, James Marion, American surgeon: b. Lancaster County, S. C., 25 Jan. 1813; d. New York, 13 Nov. 1883. He was graduated from South Carolina College in 1832; studied medicine at Charleston and at Philadelphia, and in 1835 began to practise. He was settled at Montgomery, Ala., during 1840–53, where he became known for his successful operations for strabismus and club-foot. In 1845 he made known his hypothesis on the cause and proper treatment of *trismus nascentium*. The effectiveness of the treatment was later demonstrated by a long series of experiments. In the same year he began experiments to test a treatment he had conceived for vesico-vaginal fistula, in the course of which he devised the silver suture and several instruments, the chief of which is the duckbill speculum known as the Sims speculum. In 1853 he removed to New York and shortly began a movement for the establishment of a hospital for the diseases of women. A temporary structure was built in 1855, and a charter and appropriation were granted by the legislature in 1857 for the permanent institution, built in 1866 on the pavilion system. Dr. Sims went to Europe in 1861 and performed the operation for vesico-vaginal fistula in the hospitals of London, Paris, Edinburgh and Dublin. In 1862 he settled in Paris and secured a lucrative practice. From 1864 to 1868 he practised in London, and in the latter year returned to America. He was again in Paris in 1870, and was surgeon-in-chief of an Anglo-American ambulance corps that treated both French and German soldiers after the battle of Sedan. In 1872 he was reappointed a member of the board of surgeons of the Woman's Hospital, but resigned in 1874. Among his published works are ‘Trismus Nascentium’ (1846); ‘Silver Sutures in Surgery’ (1868); ‘On Intra-Uterine Fibroid Tumors’ (1874); ‘Clinical Notes on Uterine Surgery’ (1865); ‘The Anglo-American Ambulance’ (1870); ‘Treatise on Ovariotomy’ (1873); ‘History of the Discovery of Anæsthesia’; ‘The Story of My Life’ (1884). A bronze statue of him is in Bryant Park, New York. Consult Flint, Austin, ‘In Memoriam James Marion Sims’ (New York 1886).

SIMS, Thomas M., American fugitive slave, and subject of a celebrated case under the Fugitive Slave Law. He was born a slave, escaped from his master in Savannah, Ga., in 1851 and succeeded in reaching Boston, Mass. He was arrested there 3 April 1851, and was held under the Fugitive Slave Law. The case aroused the abolitionists of Boston and men such as Wendell Phillips, Theodore Parker, William Lloyd Garrison and Thomas W. Higginson were prominent in the effort made to prevent his return to his master. A writ of habeas corpus was obtained after some difficulty, but was set aside, and Sims was eventually escorted to a ship under armed guard and returned to his master in Savannah. He was afterward taken to Vicksburg, and in 1863 he escaped to Grant's army at Vicksburg. He became a messenger in the Department of Justice, Washington, D. C., in 1877.

SIMS, William Snowden, American vice-admiral: b. Port Hope, Canada, 15 Oct. 1858. He was graduated at the United States Naval Academy in 1880, and was promoted through the various grades to captain in 1911, rear-admiral 5 Jan. 1917 and vice-admiral 28 May 1917. He served on the North Atlantic, Pacific and China stations, and was naval attaché at the American embassies at Paris and Petrograd in 1897–1900. In 1901–02 he was aide to the commander-in-chief of the Asiatic fleet; in 1902 fleet intelligence officer and inspector of target practice for the Asiatic fleet on board the *New York;* and in 1908–09 he was naval aide to President Roosevelt. He was commander of the battleship *Minnesota* in 1909–11; and in 1911–13 he served on the staff of the Naval War College, Newport, R. I. He commanded the Atlantic torpedo flotilla in 1913–15. He was appointed commandant of the naval station at Narragansett bay and president of the Naval War College at Newport in 1916. After his promotion to rear-admiral in 1917 he was commissioned special naval representative and observer to Great Britain. After the United States declaration of war on Germany he received command of the United States fleet in European waters, 28 April 1917, his elevation to vice-admiral following on 28

May. He remained in command of the fleet throughout the remainder of the war, and on 23 Feb. 1919, after the withdrawal of the main fleet to home waters was decided upon it was announced by the Navy Department that Vice-Admiral Sims would return to his duties as president of the Naval College. Throughout his career his name was connected with the improvement of naval gunnery and the reform of naval construction; and he was known as a naval writer and critic. His conduct of the United States fleet in European waters during the country's participation in the European War received the highest praise at home and abroad, and he was the recipient of many honors, among them the British Grand Cross of the Order of Saint Michael and Saint George in 1918, and the British Order of Merit in 1919.

SIMS, Winfield Scott, American inventor: b. New York, 6 April 1844. He was graduated at the Newark, N. J., High School in 1861, and served during the Civil War in the 37th New Jersey regiment. After the war he devoted himself to electrical experiments. He constructed an electric motor, which propelled a 16-foot boat at the rate of four miles an hour. He was the first to apply electricity to the propulsion and guidance of movable torpedoes. He also devised a dynamite boat with a speed of 18 miles an hour to be used in harbor and coast defense. He was also the inventor of the wireless-dirigible torpedo, of the Sims-Dudley dynamite gun and a dynamite gun for use with dirigible war ships, and an aeroplane dynamite gun.

SIMSBURY, sĭmz'bĕr-ĭ, Conn., village and township in Hartford County, on the Farmington River, 10 miles northwest of Hartford, on the Central New England and the New York, New Haven and Hartford railroads. It has a high school and manutactures safety fuses. Pop. township 2,537.

SIMSON, Robert, Scottish mathematician: b. Ayrshire, 14 Oct. 1687; d. Glasgow, 1 Oct. 1768. He was educated at the University of Glasgow, where he became professor of mathematics in 1711. By the advice of Halley he directed his private studies to the restoration of the ancient geometers. His first labor in this direction was to restore the Porisms of Euclid. In 1735 he published his 'Sectionum Conicarum Libri Quinque,' a work intended as an introduction to the study of Apollonius of Perga. The next object of his labor was the 'Loci Plani' of Apollonius, which he completed in 1738, but which he did not venture to publish till 1749. The restoration of the elements of Euclid was the great object of Dr. Simson's care, and an edition of the 'Elements' was published in 1756, a work which has always enjoyed a high character both for precision in the definitions and accuracy in the demonstrations. The 'Sectio Determinata' of Apollonius next occupied his attention, but this work was not published till after his death when it was printed with the 'Porisms of Euclid.'

SIMSON, Sampson, American philanthropist: b. Danbury, Conn., 1780; d. New York, 7 Jan. 1857. He was graduated from Columbia College in 1800, then studied law with Aaron Burr and was admitted to the bar in 1802. His professional career was brief, and he preferred the leisurely life of a country gentleman in Yonkers, where his estate was extensive. He was founder of the Mount Sinai Hospital of New York, having presented the ground on 28th street, near Eighth avenue, whereon it was first located as «Jews' Hospital.» He also established the still existing «North American Relief Society for Indigent Jews in Jerusalem.»

SIMULTANEOUS EQUATIONS, in mathematics, two equations are simultaneous when the value of the unknown quantities which enter them are the same in both at the same time. A group of equations is simultaneous when the value of the unknown quantities is the same in them all at the same time. See EQUATION.

SIN, any wilful thought, word, deed or omission contrary to the law of God. This definition does not cover Original Sin (q.v.), save in so far as it was Adam's own transgression: in distinction from original sin all other sins are called actual sins. Offenses against purely human law may be crimes, misdemeanors, etc., and the same may be called sins; but a sin is not necessarily a crime, no matter how heinous it may be. For example, the most grievous sins may be sins purely of thought or of desire or intention: of these human law cannot take cognizance, and hence they are not crimes or misdemeanors. Sins are variously classed, namely, as of omission and of commission; as against God, our fellow-men or ourselves; as premeditated and unpremeditated; internal and external; mortal and venial. Regarding these several kinds of sin and classifications of sins, theologians of all schools are in agreement, except the last division, that of mortal and venial. The divines of the Protestant churches in the time of the Reformation, while admitting a difference among sins so that some would be more heinous than others, looked on all sins alike as mortal; that is, deserving everlasting punishment. Thus Calvin writes: «The sins of believers are venial, not because they do not merit death, but because there is no condemnation for those who are in Jesus Christ, their sin not being imputed»; even the daily falls of good men make them «liable to the penalty of death before the judgment seat of God» (Calvin, Inot. Chr. iii, 4). In the doctrine of the Roman Catholic Church it is taught that one guilty of sins which in their own nature merit eternal death cannot be in friendship of a holy God; hence a distinction is drawn between sins mortal and sins venial; mortal sins are against the very end of God's law, which is the love of God, and they deserve everlasting punishment; venial sins, the daily falls of good men, do not annihilate the friendship of the soul with God, and grace is still left whereby the sin may be repaired. Consult 'Catechismus Concilii Tridentini'; Hyde, W. D., 'Sin and Its Forgiveness' (Boston 1909); Orchard, 'Modern Theories of Sin' (ib. 1911); Mackintosh, R., 'Christianity and Sin' (New York 1914); Tangueray, 'Theologie Moralis et Dogmatica' (6 vols., New York 1908 et seq.); Tennant, F. R., 'Concept of Sin' (ib. 1913).

SIN OF JOOST AVELINGH, The, the first work of «Maarten Maartens» (q.v.) (1890) (J. M. W. van de Poorten-Schwartz). This «clever and fascinating study of human motives» at once gained for its author the attention of critics and reading public.

SINAI, sī'nā or sī'nī, Arabia, a mountain peak rising above the rugged surface of the peninsula which projects between the Red Sea and the Gulf of Suez, on one side, and the Gulf of Akaba on the other. This is the sacred mountain of Biblical fame, where Moses received the stone tablets containing the Ten Commandments. The series of mountains covering the entire peninsula consists of three distinct mountains, which are known individually as Mounts Serbal, Catharine and Umm Shomer, and also by the general name of Sinai. They are respectively 6,750, 8,540 and 8,000 feet high, and penetrated by narrow, deep valleys and ravines, enclosed by perpendicular walls of rock. The numerous caves were the homes of hermits. The mountains stand out in bold relief. There have been many controversies as to which peak might be the «Mountain of the Law,» and Mount Serbal now bears that distinction, after much research. At the foot of Mount Musa stands the convent of Saint Catharine. The rock inscriptions, dating from an early era, are interesting. Consult Beke, ‹Discoveries of Sinai in Arabia and of Midian› (London 1878); Gressmann, Hugo, ‹Mose und seine Zeit› (Berlin 1913); Dillmann, C. F. A., ‹Die Bücher Exodus und Leviticus› (Leipzig 1880); Palmer, E. H., ‹The Desert of the Exodus› (New York 1872); Sayce, A. H., ‹The Higher Criticism and the Verdict of the Monuments› (London 1894); Winckler, Hugo, ‹Sinai and Horeb› (in ‹Encyclopædia Biblica› (New York 1903).

SINAITIC MANUSCRIPT. See Bible.

SINALOA, sē-nä-lō'ä, Mexico, a state bounded on the north by Sonora and Chihuahua, on the east by Chihuahua and Durango, on the south by the territory of Tepic and the Pacific Ocean and on the west by the Gulf of California. Area, 33,671 square miles. From the Gulf, the land rises gradually to the Sierra Madre Mountains, the principal range in the state. There are numerous rivers, some of which are navigable. An excellent natural harbor is that of Topolobampo, an important railway termination. The district of mines (gold, silver, copper, iron and lead) is in the east and the deposits of metals there are regarded as perhaps the most valuable in Mexico; there, also, the climate is cool, frosts occur frequently and the rainfall is excessive. The low and hot western belt is devoted to agriculture, the chief products being cereals, cotton, tobacco, sugar-cane, coffee and fruits. These crops in normal times yield about $8,000,000 annually, and the cattle industry about $9,000,000 (value of Mexican «dollar,» 0.50). The development of Sinaloa and the west coast of Mexico generally, which, before the revolution broke out in 1911 had been rapid and solid, has been, since then, retarded by the unsettled state of the Mexican west and northwest coast country. However, a steady improvement toward stability and progress was noticeable in 1918. The three chief ports are Topolobampo, Altata and Mazatlán. Interior communication is furnished by the Sinaloa and Durango Railway, and the Kansas City, Mexican and Orient, and by good wagon roads; communication with other coast states and foreign countries, by the Pacific Mail Mexican International, and other steamship lines. The capital of the state is Culiacán, a town of 22,000 inhabitants, connected by rail with the port of Altata. It has a government palace, cathedral, cotton mills and other manufactures. The largest city in the state, and the chief Pacific port of the republic, is Mazatlán (pop. 27,000), which was built on a small peninsula opposite Olas Atlas Bay. Total population of the state, 317,000.

SINCERE BRETHREN. See Religious Sects.

SINCERITY, Order of. See Orders, Royal.

SINCLAIR, Alexander Maclean, Canadian Presbyterian clergyman and Gaelic scholar: b. Glen Bard, Nova Scotia, March 1840. He was educated at the Presbyterian College, Halifax, and was ordained in the Presbyterian ministry in 1866. He held various pastorates until 1907, when he was appointed lecturer on Gaelic language and literature at Dalhousie University. He also gave lectures throughout Nova Scotia. Author of ‹A Collection of Gaelic Poetry› (1881); ‹Gaelic Bards from 1411 to 1715› (1890); ‹Gaelic Bards from 1775 to 1825› (1896); ‹Mactalla nan Tur› (1901); ‹Filidh na coille› (1901), etc.

SINCLAIR, Sir John, Scottish author and agriculturist: b. Thurso Castle, Caithness, Scotland, 10 May 1754; d. Edinburgh, 31 Dec. 1835. He was educated at the universities of Edinburgh, Glasgow and Oxford, was called to the bar in 1775 but did not engage in practice. He was elected to Parliament in 1780, served with brief interruptions until 1811 and in 1786 was created a baronet. He took an active share in building up the fisheries and in promoting agricultural interests, founded the Scottish Society of Wool Growers in 1791, and the Board of Agriculture in 1793, acting as the first president of both associations, and in that capacity maintained an extensive correspondence with General Washington. The most remarkable work of his life was the compiling of the stupendous ‹Statistical Account of Scotland, drawn up from the Communications of the Ministers of the Different Parishes› (21 vols., 1791–99). His other publications include 367 pamphlets and 18 other volumes, among which are ‹History of the Public Revenue of the British Empire› (3 vols., 1785–89, 3d ed., 1803–04); ‹Code of Health and Longevity› (4 vols., 1807); ‹Code of Agriculture› (1819), etc. Consult ‹Correspondence of Sir John Sinclair› (2 vols., 1831).

SINCLAIR, May, English author: b. Rock Ferry, Cheshire, 19th century. She was educated at Ladies' College, Cheltenham, and became a writer of verse and fiction. Her first striking success was a novel ‹Divine Fire› (1904), which reached a wide popularity in the United States. Soon after the outbreak of the European War she went to Belgium as a nurse, Author of ‹Audrey Craven› (1906); ‹The Judgment of Eve› (1908); ‹The Three Brontës› (1912); ‹The Return of the Prodigal› (1914); ‹A Journal of Impressions in Belgium› (1915); ‹The Belfry› (1916); ‹A Defense of Idealism› (1917); ‹Tree of Heaven› (1917), etc.

SINCLAIR, Upton, American author and Socialist: b. Baltimore, Md., 20 Sept. 1878. He was graduated at the College of the City of

New York in 1897 and in 1897–1901 was engaged in special study at Columbia University. He assisted the United States government inspection of the Chicago stockyards in 1906; founded the Helicon Home Colony at Englewood, N. J., in 1906, an experiment in social community living which was terminated by the destruction of the buildings by fire in 1907; and was Socialist candidate for Congress from New Jersey in 1906. He founded the Intercollegiate Socialist Society and is a contributor to *Physical Culture*. His time is now chiefly devoted to literature. Author of 'Springtime and Harvest' (1901); 'The Journal of Arthur Stirling' (1903); 'The Jungle' (1906); 'The Overman' (1907); 'The Money-changers' (1908); 'The Fasting Cure' (1911); 'Plays of Protest' (1911); 'Damaged Goods' (1913); 'King Coal' (1917); 'Jimmie Higgins' (1919), etc.

SINCLAIR, William Macdonald, English Anglican clergyman: b. Leeds, 3 June 1850; d. 5 Dec. 1917. He was educated at Balliol College, Oxford, took holy orders and became examining chaplain to the bishop of London, honorary chaplain to the king and in 1889 appointed archdeacon of London and canon of Saint Paul's. He retired from London to a country church in 1911. He has written 'The Psalms in the Original Rhythm' (1879); 'Lesson on the Gospel of Saint John' (1882); 'Christ and Our Times' (1894); 'The Churches and the East' (1898); 'The Church and the Nonconformists' (1902); 'The Authority of Sunday' (1903), etc.

SIND, SINDH, or SCINDE (from *sindhu*, a collection of waters), British India, an extensive territory and division of the province of Bombay, comprising the lower course and delta of the Indus, and bounded on the west and northwest by Baluchistan; northeast by the Punjab; east by Rajputana; and south by the Rann of Cutch and the Arabian Sea; length, north to south, about 380 miles; greatest breadth, east to west, 280 miles. Area of part under British administration, 46,986 square miles. This with the native state of Khairpur makes a total area of 53,031 square miles. The capital is Hyderabad, the chief port of Karâchi, both of which are connected by rail. The seacoast, except at the western extremity (Cape Monza), is very low, being composed of mud-banks deposited from the rivers of the delta, or of low hills of sand blown in from the beach, the whole shore being a dreary swamp, destitute of trees or shrubs, and submerged at spring tides. In the dry season the stiff clay soil, which is strongly impregnated with nitre, bears an abundant crop of gigantic grass, with furze, mimosas and cacti, and affords pasture to numerous herds of buffaloes. West of the Indus the Hala Mountains approach the river at Sihwan and come close to the sea at Cape Monza. Between the former place and Karâchi, on the northwest mouth of the Indus, is a maze of hills, the highest of which reach an elevation of about 1,500 feet, terminating abruptly on the west bank of the stream. The general appearance of Sind is that of a jungly wilderness; spotaneous vegetation takes the place of cultivation.

The climate is dry and sultry. In the upper districts frost is not unknown, and the heat often varies in the 24 hours from 40° to 84° F. The hot season lasts from March to September, the cold season lasts from October to March; and the changes from the one to the other are so rapid that spring and autumn are not experienced. Sind agriculture is still in a primitive state. In those parts under tillage the land yields two crops annually; the spring crop consisting of wheat, barley, millet, durra, sesamum and other oil seeds, hemp, opium and tobacco; the autumn crop of rice, maize, cotton, sugar and indigo. Rice, wheat and maize form the principal staples, being both extensively used for food and exported. Pulse, pumpkins and other succulent plants are raised, and the date, mango, plantain, pomegranate, lime, citron, tamarind, fig, mulberry, pistachio, melon and grape are among the principal fruits. In moist parts gigantic grasses abound. The wild animals of the country include the tiger, panther, hyena, jackal, wolf, fox, antelope and other kinds of deer, wild ass and wild hog. The domestic animals include camels, buffaloes, horses, sheep and goats. The camels are valuable, both as beasts of burden and as furnishing a rich milk. Their hair is used for making shawls and cloths. The buffaloes are prized for their hides, flesh and milk. From the latter *ghee* is made. This is an important article of traffic in Indian commerce. Birds are in great variety. Fish form a chief part of the food of the poorer people. Venomous snakes, scorpions and centipedes are common.

The Sindians, a mixed race of Jats and Baluchis, are partly of the Hindu and partly the Mohammedan faith. They are well made, and handsome, tall, inclined to corpulence and of dark complexion. The women are noted for their beauty. The Sind language differs little from the Hindi of Upper India, though it is more regular and complete in the inflexions of its nouns and verbs. Baluchi is also much spoken, especially in the districts west of the Indus; and Persian may be considered as the language of the higher orders. The natives are very ingenious as weavers, turners and artisans, and are specially noted for their skill in the production of wooden lacquer work, famed throughout India. The leading Sind textile fabrics are coarse silk, cotton or mixed cloths. The silk goods are woven from silk imported from China and Persia. Sind imports British manufactured goods, sugar, groceries and spices and raw silk. Its exports comprise rice and other grains, ghee, indigo, potash, dried fish, wool, hides. There is a transit trade with the Punjab, Persia and Afghanistan, which has been improved by the Indus Valley Railway. The harbor of Karâchi has been improved at considerable expense, and trade is increasing.

Sind was governed by Hindu rajahs at the time of its invasion by Alexander the Great, but subsequently, after many changes, it became an independent state. It was finally subdued by the Emperor Akbar in 1580 since which period it has always been either nominally or really tributary. In 1739 it fell under the power of Nadir Shah, but on his death it reverted to the imperial sway of Delhi. It was in 1756 presented by the Mogul court as a dowry to Timur Shah Derani, king of Kabul, to which country it was, down to its annexation to British India, deemed subordinate. The country, however, was, during the whole of the 18th and the early part of the 19th century, a scene of almost constant civil dissension, caused by disputes between the two leading tribes of Baluchis, which led at last to the elevation to power of the Talpur dynasty of the «Amirs.» The government under these Amirs was a wholly unchecked military despotism, upheld by a feudal soldiery, supported by their respective chieftains, and estimated to have numbered 102,000 men. The hostility displayed by the Amirs of Sind to the British, during and after the operations against the Afghans, led ultimately to its invasion by British troops, and conquest by Sir C. Napier's victory at Miani, 17 Feb. 1843. It was soon afterward annexed to the presidency of Bombay. Pop. about 3,500,000, of which over 2,600,000 are Mohammedans; 850,000 Hindus; while the remainder consist of Sikhs, Christians and several native sects. Consult 'The Imperial Gazetteer of India' (Oxford 1908); Burton, R. F., 'Sind Revisited' (London 1886); Hughes, 'A Gazetteer of the Province of Scinde' (London 1876).

SINDING, Christian, Norwegian composer, brother of O. L. Sinding (q.v.): b. Königsberg, 11 Jan. 1856. He studied under Reinecke at the Leipzig Conservatory in 1874–77, and later studied at Dresden, Munich and Berlin. He established himself in Christiania as an organist and teacher; and gained also a reputation as a pianist, and as a composer of music characterized by great elegance and charm. His compositions are for the piano and for stringed instruments, and include the Rondo Infinite for orchestra; Violin Concerto in A; Piano Concerto in D Flat; Quintet in D minor; the opera 'Der Heilige Berg' (1910); besides several suites, caprices, studies and sonatas, as well as songs and arrangements of folksongs.

SINDING, Otto Ludwig, Norwegian artist, brother of the preceding: b. Königsberg, 20 Dec. 1842; d. Munich, Germany, 12 Nov. 1909. He studied under Eckersberg in Christiania, under Piloty at Munich and under Riefstahl at Carlsruhe. While his work is on the whole much influenced by foreign study, many of his landscape and genre paintings are typically Norwegian. He also paints marines and religious subjects. Among his works are 'The Surf'; 'From Reine' (Christiania Gallery); 'Struggle at a Peasants' Wedding,' etc.

SINDING, Stefan Abel, Norwegian sculptor, brother of the preceding: b. Trondhjem, 4 Aug. 1846. He took his Ph.D. at the University of Christiania, afterward studying sculpture at Christiana and Berlin. He has worked in Paris, Rome and Christiania and is regarded as the foremost sculptor of Norway. His work is highly original and realistic, and is characterized by superb strength and beauty. A collection of his best work was made by Jacobsen and placed in the Ny-Carlsberg Glyptothek. Among his works are 'The Barbarian Mother' (1882); 'Man and Woman' (1889); 'The Valkyrie' (wood, 1882; bronze, 1908); 'May' (1910); 'Joy of Living' (1913); 'Night' (1916), etc. He has also executed statues of Ole Bull, Ibsen, Björansen and one of himself (1916).

SINE, *in mathematics,* one of the most commonly used trigonometrical ratios of an angle. It is the perpendicular dropped from one end of a circular arc upon the radius of the other end; or in the case of a triangle a perpendicular from one side of an angle to the other. With the usual notation it is the ratio of the perpendicular to the hypotenuse. The sine of an arc is the sine of the angle subtended by the arc. The cosine is the base line from the angle to the sine. A sine-curve is a sinusoid; a subversed sine is the cosine increased by the radius; a versed sine is the radius (or unity) minus the cosine. In plane triangles the sides are to each other as the sines of the opposite angles; in spherical angles, the sines of the sides are to each other as the sines of the opposite angles. Hence it appears how important the sine is for finding certain parts of triangles, from certain given parts. See TRIGONOMETRY.

SINECURE, strictly speaking, an office which has no work attached to it, but generally applied to a political office with liberal salary, and comparatively little to do. In the United States no office is supposed to be absolutely free from actual service on the part of the incumbent, but sinecure offices were formerly very numerous in the English public service. They were used to enrich ministers of state and their families; Sir R. Walpole, for example, presented his son Horace to three or four sinecure places which brought him in a large income. The number of such places has been greatly diminished by modern reforms; the stewardship of the Chiltern Hundreds and some other offices of merely nominal profit are retained, because by accepting one of them a member of the House of Commons is enabled to vacate his seat.

SING SING, N. Y. See OSSINING, N. Y.

SINGAN-FU, sē-ngän'foo, a city of northeast China, the capital of the province of Shen-si, near the centre of the province, a few miles south of the Wei-ho River. It lies on one of the principal commercial roads of the empire, and at the head of navigation for large junks on the river. The city is surrounded by well-preserved walls, and contains many objects of historic interest. During the 12th century B.C. it was the capital of China, and the Chinese court retired to this city when the allied powers occupied Peking in 1900. For additional information see SIAN-FU.

SINGAPORE, sĭng-gạ-pōr′, or **SINGAPUR,** East India, a British possession consisting of a small island and a strongly fortified seaport city, the capital of the Crown colony of the Straits Settlements, off the southern extremity of the Malay Peninsula, commanding the eastern entrance to Malacca Strait, the chief route to the Far East.

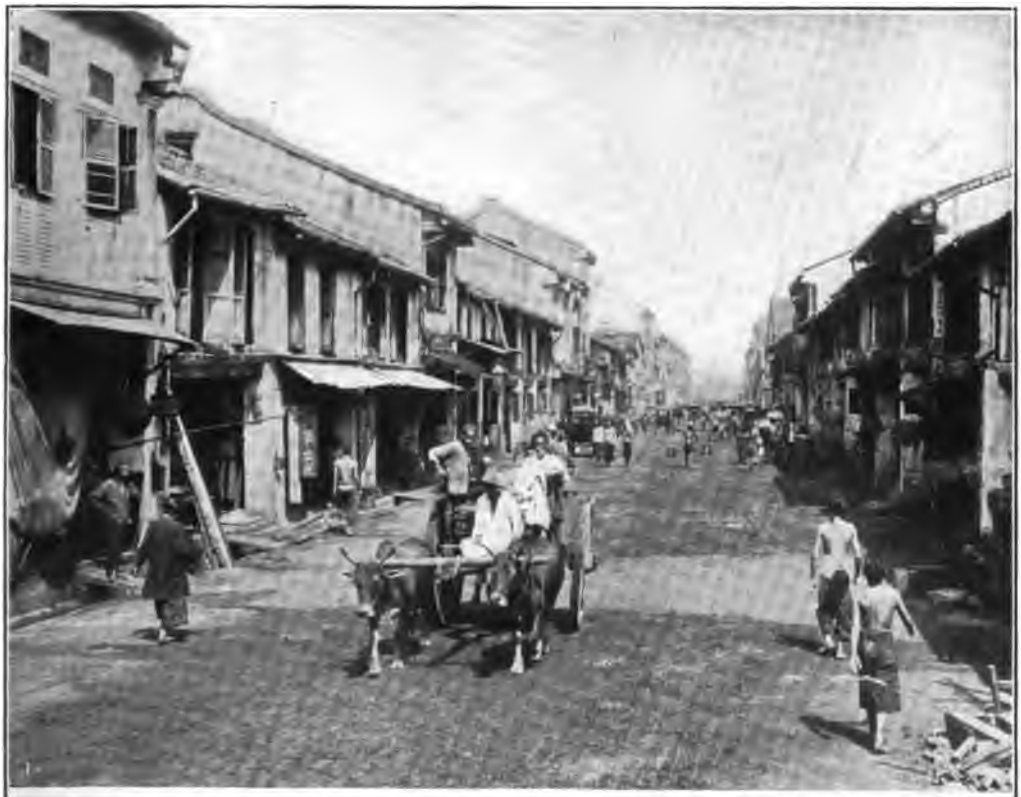
The municipality was founded in 1819 by the East India Company, through the foresight and good management of Sir Stamford Raffles, to whose memory a fine monument has been erected. Since 1824 it has been the capital of the consolidated governments of Singapore, Penang and Malacca. The city is well-built, has a sea frontage of about six miles and a fine harbor with extensive docks and wharves. It has become the commercial entrepôt of southern Asia and the Indian Archipelago, and carries on such extensive transactions that it has been termed «the Liverpool of the East.» The port is free to vessels of all kinds and nations, without charges on exports and imports, anchorage, etc., only light dues being payable. Singapore is a coaling station of the British navy, and is defended by forts carrying heavy ordnance, and by submarine mines. The imports from Great Britain comprise cottons (the largest import), iron, machinery, coals, hardware and various manufactures; the exports thither consist of tin, coffee, rice, sugar, nutmegs, mace, sago, tapioca, catechu, gambier, hides, rattans, gutta-percha and numerous sundries. The imports from the continent of Europe and the United States consist of wines, spirits and liquors, manufactured goods, provisions, etc., in exchange for similar commodities to those sent to Britain. Singapore carries on an extensive trade with Calcutta, Madras and Bombay. The annual value of exports from and imports into Singapore, taken together, is $275,000,000 and upwards, being exceeded by only three other Asiatic ports. The total tonnage, entered and cleared, exceeds 17,500,000 annually. There are a number of fine buildings, as the governor's palace, the city hall, two cathedrals, a museum and library. There is also a fine public park and botanical gardens. A railway has been constructed from Singapore to Kranji, on the Johore Straits. The city is well supplied with water, but in other respects its sanitary arrangements are backward.

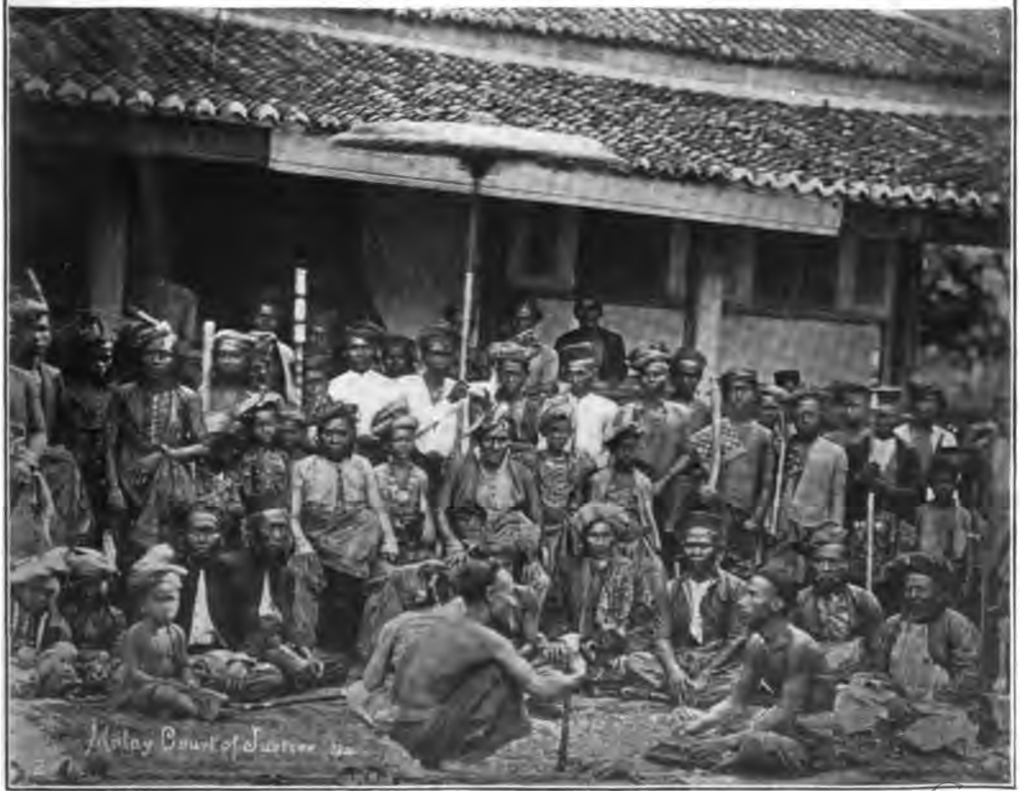
The island of Singapore is of rhomboidal shape, about 27 miles long and 14 miles broad; area, 206 square miles. It is separated from the mainland by a narrow strait two miles to one-half a mile in breadth. Its surface is generally undulating, rising in some parts into round verdure-clad hills, the highest of which, called Bukit-Tima or the Tin-hill, rises 520 feet above the sea. Tin smelting is the chief of the settlement's industries, more than half of the world's tin product coming from the smelting works of Pulan Brani. The fisheries also are very productive and give employment to a large number of people. The chief cultivated plants include coffee, pineapples and other fruits, cocoanuts, aloes, gambier, pepper, indigo, sugarcane, etc. Fruits and vegetables are grown in immense variety and to great perfection. The British settlement dates from 1819 when permission was obtained to build a factory on the southern shore of the island. By treaty in 1824 they purchased for 60,000 Spanish dollars and a life annuity to the Sultan of Johore and his resident officer of 24,000 dollars, the sovereignty and fee simple of the island, as well as of all the seas, straits and islands to the extent of 10 geographical miles (11½ miles) around. The climate is very hot, moist and oppressive. The population is mainly Chinese, with a sprinkling of Malays and East Indians, and about 4,000 whites. Pop. about 235,000, of whom about 193,000 are in the municipality. See STRAITS SETTLEMENTS.

SINGER, Isaac Merritt, American inventor: b. Oswego, N. Y., 27 Oct. 1811; d. Torquay, England, 23 July 1875. He was a machinist, and having spent years of study on the improvement of sewing machines obtained a patent on a single-thread, chain-stitch machine. He established in New York a factory in conjunction with Edward Clarke, a wealthy lawyer, and made a fortune in the manufacture of machines which bore his name. He resided at Paris and Torquay during the later years of his life. The Singer building is one of the notable edifices of New York, and the Singer tower was at one time the highest office building in the city.

SINGER, Isidore, American Jewish editor and author: b. Weisskirchen, Moravia, Austria, 10 Nov. 1859. He took his Ph.D. at the University of Vienna in 1884, and studied also at the University of Berlin. He founded and edited *Allegemeine Osterreichische Literaturzeitung* at Vienna in 1884–85; and in 1887 he became secretary and librarian to Count Alexandre Foucher de Careil, French Ambassador to Vienna, whom he accompanied to Paris. He was later employed in the Bureau de la Presse of the French Foreign Office, and subsequently founded *La Vraie Parole*, of which he was editor-in-chief, and made the paper an opponent of the anti-Semitic *La Libre Parole*. He went to Italy in 1891, and in 1895 came to the United States, where he succeeded in carrying out the project he had made his life work, the publication of the 'Jewish Encyclopedia' (12 vols., 1901–05), of which he was the originator and managing editor. He also originated the project of the 'International Insurance Encyclopedia' (Vol. I, 1910); and the 'German Classics of the XIXth and XXth Centuries' (20 vols., 1913–14); and was author of 'Berlin, Wein und der Antisemitismus' (1882); 'Le Prestige de la France en Europe' (1889); 'Russia at the Bar of the American People' (1904); 'Christ or God?' (1908), etc. He is at present literary editor of Joseph A. Judd and Company, and associate editor of *Arts and Decoration*.

SINGHALES, SINGHALESE (sĭn-gă-lēz'), **LANGUAGE AND LITERATURE.** Singhalese is the speech of 70 per cent of the native inhabitants of Ceylon. It is an Aryan tongue and nearly allied to Pali, but it contains many foreign words. For this reason there has been much dispute as to its classification. There is a material difference between the vernacular and the written language. The latter has a copious vocabulary and a regular grammar, and is capable of elegant style. Its alphabet has 50 letters, but these represent only 30 sounds (7 vowels, 23 consonants), belonging to the Singhalese. Modern Singhalese has become an analytical language very largely, though there are still in evidence traces of its highly inflected ancient condition. In fact the Singhalese verb seems to have been handed down little changed from the synthetic age of the tongue. The other sounds are heard only in Sanskrit words or are indistinguishable. In the Singhalese words occurring in the following illustrations of the grammar of the language the vowels have the values they have in Italian, the consonants, including *ch*, *sh* and *j* have the sounds given to them in English, except that *g* is always hard, and that the diphonics *chh*, *jh*, *th*, *dh*, *ph* and *bh* stand for sounds peculiar to Singhalese. In Singhalese grammar there are three genders; nouns masculine end mostly in *a*, plural *o*, *an*, *aru*; feminine in *i*, plural *u*, *varu*; neuter in *a*, *u*, plural adding *val*, or dropping the final syllable. Examples: *nuvara*, city, *nuvaraval*, cities; *kaduva*, sword, *kadu*, swords. The principal case endings, masculine and feminine, are genitive, *ge*, *ne*; dative, *ta*, *da*; accusative, *va*; ablative, *gen*, *nen*. The neuter





1 Street scene in Singapore

2 Malay Court of Justice, Singapore

endings of the above four cases respectively are *ē, ata, ava, en*. Example: *manuspaya* (Lat. *homo*), man; *gūnī* (Lat. *mulier*), woman; *oluva* (Lat. *caput*), head; genitive *manuspayăge, hominis; gūnīgē, mulieris; oluvaē, capitis;* dative, *manuspayă, homini,* etc.; accusative, *gūnīva, mulierem,* etc.; ablative, *oluven, capite,* etc., as above detailed: plural, *manuspayo, homines; alu, capita; manuspayinnē, hominum,* etc. The adjectives are indeclinable. There are no less than 14 different pronouns of the second person, the use of them being regulated by the rank, both of the speaker and the person addressed. The Singhalese literature, which is not very extensive, comprises several original poems of some merit, and an extensive and interesting series of native chronicles, together with a considerable body of devotional works and other religious writings. The oldest Singhalese document extant is a glossary to the commentary on the 'Dhammapada' (10th century). The language also contains histories and grammars. The sacred books of the Singhalese, originally written in Pali, and which have been translated into the popular tongue form a considerable body of literature which is widely read and distributed over most of the island. Consult Alwiz, 'Singhalese Hand-Book in Roman Characters' (Colombo 1880); Carter, 'English-Singhalese Dictionary' (Colombo 1891); Clough, 'Singhalese-English Dictionary' (Colombo 1890); Geiger, 'Literatur und Sprache der Singhalesen' (Strassburg 1901); Gunasekara, 'Comprehensive Grammar of the Singhalese Language' (Colombo 1891).

SINGHARA NUT, the fruit of a floating aquatic plant *Trapa bispinosa*. The nut is large, about three-quarters of an inch thick, having normally four spines, two of which are often absent. It has a sweet starchy kernel, which is a staple food of the natives of Cashmere.

SINGING. See VOICE AND VOICE CULTURE.

SINGLE STANDARD. See BIMETALLISM.

SINGLETAX, The, is a name for the social reform which Henry George proposed in 'Progress and Poverty.' This book was first published in 1879, but the social reform it proposes had been foreshadowed by its author in his monograph, 'Our Land and Land Policy,' published in 1871. He had discussed it, also, in newspaper editorials and magazine articles, and had subjected it to criticism through extensive personal correspondence. Having satisfied himself of the economic and moral soundness and the political feasibility of the reform, he devoted his life, from the beginning of his task of writing 'Progress and Poverty' in 1877 until his death in 1897, to popularizing it and to promoting political action in furtherance of its legislative adoption. In the course of this agitation he wrote several additional books only less famous than 'Progress and Poverty,' among them being 'Social Problems,' 'Protection or Free Trade,' an open letter to Pope Leo XIII on 'The Condition of Labor,' 'A Perplexed Philosopher' (a criticism of Herbert Spencer in certain respects), and a posthumously published incomplete treatise, 'The Science of Political Economy.' In addition he carried his agitational work to the lecture platform, making two tours of Great Britain and Ireland, one of Australasia, and several through the United States and Canada. As an editor he advocated the reform first in the San Francisco *Post* (a daily newspaper) and later in the New York *Standard* (a weekly), both under his own proprietorship; and as a magazine contributor he discussed it in the *Popular Science Monthly*, the *North American Review*, the *Century Magazine*, the *Arena*, and periodicals of similar character in the United States and abroad. His political activities — including two gigantic campaigns for mayor of New York (1886 and 1897), in the latter of which he suddenly died a few days before the election, were inspired and rigidly governed, like his authorship and his editorial work and lecturing, by his devotion to the Singletax.

Coming first into use in 1888, this name is the one now best known in the United States, Canada and Australasia. It had currency in Great Britain for a time, but the more familiar term there has for several years been «taxation of land values.» In Germany the current name is «Bodenreform.» Numerous other designations have been used; «land restoration,» «anti-poverty,» «free soil,» «land and labor,» etc. None of them all, however, is satisfactorily descriptive. Although the reform they designate involves alterations in the prevailing systems of land tenure, it is more than a land-tenure reform; while it would begin (partly for strategic reasons) with land-value taxation, and notwithstanding that (for more substantial reasons) this method may be advocated as a permanency, yet the reform itself has no fiscal limitations; whereas the tax proposed would by a single tax, the essential character of the reform is neither the tax nor its singleness; and although the reform aims at abolition of involuntary poverty and of exploitation of labor, its fiscal method for attaining these ends is one of its characteristics. To understand the Singletax, therefore, recourse to verbal definitions of its names will not do. Its essential principles and its distinctive method for their realization in public policy and law, must be taken into account and considered together.

The primary social-utility principle of the Singletax, as formulated by Henry George, is «*association in equality*.» This is referred to as the natural law of progress. Without association progress would be impossible; without equality of opportunity to live and to earn, the progress which association produces reacts injuriously upon itself and engenders poverty as a social phenomenon.

The secondary social-utility principle of the Singletax proceeds logically from its primary one. Equality of opportunity to live and to earn being inconsistent with monopoly of natural resources, *equal rights to natural resources* (which are comprehended in the economic technical term «land») is an unescapable condition of social progress without social poverty. It is also imperative as a condition of the social morality that is implied by such phrases as «the brotherhood of man,» and which, finding religious expression in the Golden Rule of Christian teaching and «the Second Great Commandment» of Christian and Jewish teaching alike, gets political expression through the human equality clauses of the American Declaration of Independence.

Inasmuch, then, as the requirements of social morality and social utility coincide in this respect, the broad basic principle of the Singletax is a co-ordination of social utility and social morality principles. It demands *equal rights to land*.

But the basic principle of the Singletax is not necessarily inconsistent with individual titles to land. Whatever is socially useful in a public policy that recognizes individual titles may be harmonized in practice with the principle of equal rights. Any community could harmonize the two for itself, by socializing the land values within its jurisdiction. Instead of attaching equality of rights to the land directly, it could do so indirectly by socializing such of the profits of the whole area as are fairly attributable to its superior natural qualities and locational advantages. Nor would this be a difficult matter. Separation of the profits of mere ownership of natural opportunities from the profits of their use is practicable by reference to the principle of Ricardo's law of economic rent. This law affords an approximately accurate and substantially fair measure of the difference between the incomes that land users earn, whether they are landowners or not, and incomes or other financial benefits from mere ownership. For it measures with reasonable accuracy the varying financial advantages of natural resources through every gradation, from the zero value of superabundant fertile land at social frontiers to the fabulous values of rich mineral deposits easily accessible to markets and the choicest sites for business operations in a metropolitan city. These financial advantages, whether estimated as annual values or as capital values, are «land values» in Singletax terminology. To *socialize land values* is, therefore, the Singletax method of securing equality of rights to land without abolishing any of the socially useful attributes of private titles.

Nor need the reform be made abruptly, or through novel modes of land administration, so as to shock a socially useful conservatism or any reasonable sense of social prudence. It can be established by a deviation from present fiscal principles and policies, with hardly any alteration of present fiscal methods. This is the point at which taxation principles and policies enter into the Singeltax. Though considered as a fiscal reform alone, the change proposed would be in the direction of simplicity and greater fairness. It consists in so modifying real estate taxation as to exempt improvements, leaving land values to bear the burden. This modification would not of itself socialize all land values, the entire amount of real estate taxation being less annually than annual land values; but besides socializing more land values than are socialized now, it would discourage monopoly of idle land by increasing the taxation expense of keeping it idle. And it would encourage the improving of land by lessening taxation expenses of improvement and maintenance. It would, therefore, tend toward the social aims of the Singletax. This tendency would be accelerated if all personal taxes for revenue were abolished. Taxes for police regulation are not within the purview of the Singletax, though objectionable as being the most unfair and least effective of regulation methods. But with land values as the sole source of public revenues, industrial activity would be doubly stimulated: first, by freedom from tax burdens; second, by the lowering of capitalized values of natural resources through market gluts of idle land taxed out of useless and obstructive ownership. The second of those causes of industrial stimulation would be progressively intensified by the forcing upon the real estate market of still more and better idle land, consequent upon the necessity, in order to derive public revenues exclusively from land values on a falling market, of increasing the rates of taxation on capitalized land values. This action and reaction — lowering of capitalized values of land by market gluts of idle land, and consequent raising of tax rates — might result in drawing approximately all land values into public treasuries. In that event and so long as the condition continued, land values would be wholly socialized. If, however, any considerable amount remained continuously unsocialized, extensions of public functions and further improvements in public service could be made at the expense of land values until their socialization was approximately and permanently complete. To *abolish all taxes save upon land values* (in itself a beneficial tax reform) is, therefore, the *method* of the Singletax for securing all its social objects.

To summarize in inverse order of statement, the singletax is a proposal to (1) *abolish all taxation save upon land values,* for the purpose (a) of improving taxation in the direction of simplicity and fairness and in the interest of industry, by (b) exempting production from taxation, and (c) promoting tendencies toward socialization of land values; its purpose in aiming to (2) *socialize land values* being to secure (3) *equal rights to land* in harmony with individual possession, and thereby to establish (4) *equality of opportunity* to live and to earn, impossible under land monopoly but an unescapable condition of progress without poverty under the law of (5) *association in equality,* which is a natural law of (a) social utility and (b) social morality.

Objections to the Singletax are too numerous for complete consideration here. Some are frivolous, some are disingenuous, some proceed from misapprehension; but some are sincere, important and at least apparently reasonable. Most professorial economists are counted among objectors, and the economic atmosphere of the universities seems to be hostile. Yet the objections lack both system and comprehensiveness. Most comprehensive of all, perhaps, are those of Walker's 'Land and Its Rent,' a book which had vogue for a time but is now obsolete. It has been succeeded in university circles by a chapter on «The Single Tax» in Seligman's 'Essays on Taxation.' This chapter, which is limited to the subject in its fiscal aspects, is refuted in chapter XIV of Shearman's 'Natural Taxation.'

Following is a summary of current objections and answers: (1) *Objection:* The Singletax would take private property for public use without compensation. *Answer:* As land value is attributable not to individual industry but to social progress, and attaches not to industrial products but to natural resources, it is in fairness social property, for which reason the just objection is not to taking land value for public use without compensation to landowners, but to allowing its continued appropriation by landowners without compensation to the public. (2) *Obj.:* The fiscal principle upon which the Singletax rests, that of taxation in proportion to individual benefits derived from government, is false, sound fiscal principles requiring taxation in proportion to each taxpayer's ability to pay. *Ans.:* (a) Taxation in proportion to ability to pay is a principle of arbitrary tribute-levying; (b) the sound fiscal principle under democratic government is in proportion to governmental benefits. (3) *Obj.:* Taxation in proportion to governmental benefits is impracticable, the benefits being too multifarious and subtle for financial measurement. *Ans.:* (a) As land values financially reflect all governmental benefits, taxation of land values is in proportion to benefits; (b) it is, at any rate, in proportion to financial benefits, which is the crux of the matter. (4) *Obj.:* The tax would be shifted from landowner to tenant in higher rent. *Ans.:* This is (a) unthinkable with reference to unimproved land, and (b) since unimproved land would glut the market under pressure of burdensome taxation, all land would tend downward in market value. (5) *Obj.:* Unimproved building sites do not need the governmental protection that police and fire systems provide and which buildings do need; therefore, upon the principle of taxation according to benefits, building sites rather than buildings should be exempt from taxation for police and fire protection. *Ans.:* As the value of building sites is higher with police and fire protection than without, and the value of buildings is no higher (probably lower from the greater competition in building), it is building sites, not buildings, that are benefited financially by fire and police protection, and which, therefore, should bear the financial burden. (6) *Obj.:* The Singletax would produce public revenues in excess of public needs. *Ans.:* Probably not, if schools, highways and other public necessaries and conveniences were adequately provided and properly maintained. (7) *Obj.:* The Singletax would lack elasticity and therefore be unadaptable to balanced budgets. *Ans:* (a) This possibility of disadvantage would be outweighed by manifest advantages; (b) it might be obviated by estimating public expenditures after instead of prior to collection of the public revenues out of which they are paid; (c) estimates of aggregate land values for a fiscal year in advance of expenditures are as trustworthy for budget purposes as estimates of any other taxable values or of all together; (d) some Canadian municipalities have for several years balanced their budgets under a policy of land value taxation alone, and with apparent satisfaction for they have been legally at liberty to abandon the policy at the beginning of every fiscal year; (e) the problem of balanced budgets is the same with governments as with individuals, namely, to balance expenditures and savings in normal circumstances against normal incomes (in emergencies anticipating future income by drafts upon savings and by temporary borrowing), and as land values are essentially social property and therefore the normal income of governments, expenditures in government budgets should balance against land values. (8) *Obj.:* The Singletax would yield insufficient local revenues for the local needs of poor communities. *Ans.:* (a) The land values of every community are sufficient for strictly local needs; (b) the maintenance of local schools, highways, etc., are not properly local expenses, these services being necessary to maintain the standards of State and national life as a whole. (9) *Obj.:* The Singletax would exempt investors in labor products while taxing investors in land values, though both investments increased in value. *Ans.:* The latter would be taxed because their investments are in values that are produced, maintained and increased by the community and which attach to the site of the community, a common heritage the title to which investors hold as a government privilege; whereas the investments of the former are in products of industry the title to which investors hold from the producers. (10) *Obj.:* All values are produced, maintained and increased by the community. *Ans.:* The statement is not tenable; but irrespective of that, the values of labor products attach to objects of individual production, whereas land values attach to the natural resources and sites of production and of life. (11) *Obj.:* Labor products are no longer objects of individual production, individuals being unable alone to produce anything in our highly specialized industries. *Ans.:* This objection springs out of confusion of thought, specialized and individual industry not being essentially different, since every specialist contributes his labor individually so that though millions co-operate to produce, for instance a house, each individual is a housebuilder to the extent of his specialized contribution to the result. (12) *Obj.:* The Singletax would be class taxation. *Ans.:* (a) To take by taxation for public revenues property that is legally owned by one class but which morally belongs to all, would not be class taxation but common taxation; (b) it is exemption of such property, either in whole or in part, thereby necessitating taxation of legitimate private property, that is class taxation. (13) *Obj.:* It is impracticable to distinguish land values from improvement values. *Ans.* (a) Not with reference to unimproved land; (b) unimproved land affords a reasonable basis for calculating the land value of neighboring improved land; (c) the land value of building lots is easily distinguishable with approximate accuracy from the value of their buildings; (d) the value of mineral deposits is easily distinguishable with approximate accuracy from the value of their operating plants; (e) the land value of farms is as a rule so low, relatively to their improvement value, that error would usually be negligible; (f) literal accuracy of calculation is no more vital to this fiscal policy than to any other, and (g) unavoidable error would be less unfair to taxpayers and less injurious to the community. (14) *Obj.:* The Singletax would relieve great moneyed interests by placing all governmental expenses upon landowners. *Ans.:* (a) No land would be taxed unless it were valuable irrespective of its improvements, and (b) valuable land would be taxed only in proportion to its value irrespective of its improvements; (c) as moneyed interests depend for wealth and social power not upon money literally but upon titles to mineral deposits, natural forests, highways, public utilities, building sites, water powers, extensive areas of farming and grazing land and other legal privileges most of which are land monopolies, they would be more heavily taxed than they are now, while (d) landowners who are also land users (working farmers, for instance) would be taxed less heavily than now. (15) *Obj.:* The Singletax would not benefit wage-earners. *Ans.:* (a) By making the holding of land out of use unprofitable and the use of land profitable the Singletax would stimulate demand for wage-earners, thereby promoting a tendency to steady employment at increasing wages, and (b) by discouraging monopoly of idle land it would tend to make such land common, thereby expanding and maintaining opportunities for profitable self-employment. (16) *Obj.:* To take all land values for public revenue, whether by taxation or otherwise, would be unjust and justice is the prime consideration. *Ans.:* (a) The Singletax stands or falls by the test of justice; (b) as land is a common heritage which cannot be continuously monopolized without continuous injustice to the landless, irrevocable titles to land are indefensible; (c) as any private titles to land are defensible only upon the ground that social utility requires private possession, land titles are in the nature of public trusts which are violated when possessors interfere with the best use of the lands they so possess; (d) such possessors are therefore in justice estopped from objecting to land value taxes that would encourage best use; (e) as land values are in the nature of community earnings, private ownership of land values cannot in justice be granted in perpetuity; (f) as private title to land and private ownership of land values are dependent upon arbitrary governmental grants and not upon moral sanctions, these grants are in justice subject at all times to revocation, revision or exclusive taxation; (g) as it is both impolitic and unjust for governments to tie up their fiscal powers in perpetuity, land titles are at all times subject, both as matter of public policy and as matter of social justice, to taxation in governmental discretion; (h) to assert that land grants cannot justly be revised, revoked or taxed by general rule without compensating grantees or their successors, is in effect to assert that it cannot justly be done at all, for just rights to compensation rest necessarily upon just rights to that for which the compensation is exacted.

Fiscal measures tending toward the Singletax have been adopted for local purposes in several countries, beginning with New Zealand. This instance dates back to a period just before the publication of Henry George's ‘Progress and Poverty’ but several years after the publication of his ‘Our Land and Land Policy.’ It came about under the leadership of Sir George Grey, who subsequently declared himself to be in full sympathy with ‘Progress and Poverty.’ As with nearly all the instances that have followed it, the New Zealand reform was not called the Singletax nor adopted as what would now be so known. But it involved the same principle and in degree the same socializing purpose. This may be said also of the land-value fiscal system which has been adopted for local revenue purposes by municipality after municipality in New Zealand since 1896 until they aggregate nearly a hundred, including Wellington and Christchurch. It may be said also of the municipal systems of Australia, in which taxation for local revenues varies from rising percentages on land values to land values exclusively. In the German colony at Kiao-Chou, China, a system of public revenues from land values exclusively was adopted in 1899. Though crude and complex in comparison with the Singletax, this system accords with Singletax principles both fiscal and social. It is supposed to have suggested the “unearned increment” taxes of Germany and the preceding local systems of land value taxation in German municipalities that originated in 1893, both of which, also crude and complex in comparison with the Singletax, have Singletax tendencies and somewhat of the Singletax motive. Although the British measures of 1909 for land value taxation were not Singletax measures distinctively, nor at all except in minor degree, they were supported by Singletax organizations, and were denounced as Singletax measures by the opposition. Some of the municipalities of Canada have made pronounced advances toward the Singletax as a fiscal reform, Vancouver taking the lead in 1905. Although these advances were not made in the Singletax name, they were promoted by Singletax agitation; and while the tax limits are too low to effect the socializing purposes of the Singletax, its fiscal desirability seems to have been demonstrated by the fact that the municipalities, being free to abandon the system with every recurring fiscal year, nevertheless readopt it annually. In the Scandinavian countries influential agitations toward the Singletax have been reported, notably in Denmark where a general small farmers' movement, the “Cottagers,” has promoted a strong, favorable policy. In South America, especially in Argentina, the singletax appears to have the support of popular governmental influences; and much in the revolutionary proposals in Mexico indicates a drift toward Singletax ideals there.

“Local option” or “home rule” in taxation — such as is freely allowed to Canadian and Australasian municipalities, and less freely in Germany — has been a favorite method of Singletax agitation in the United States since 1889, when it was proposed by Thomas G. Shearman and approved by Henry George. The earliest efforts in its behalf were made in the New York legislature in the early '90's but without success. Among more recent efforts two unsuccessful referendum campaigns in California (1912 and 1914) are notable. The issue of each was “home rule” in municipal taxation, but the controversy turned upon the Singletax because it was popularly understood that if “home rule” were granted it would be followed by Singletax agitations for local revenue purposes. The favorable vote was large on both occasions and larger on the second than on the first. Oregon established “home rule” in county taxation by referendum in 1910, the popular issue being Singletax; but at the election of 1912 a Singletax referendum for the State was defeated, and the “home rule” measure adopted two years earlier was repealed before it had gone into practical operation. At the same election Singletax proposals under the “home rule” provision of 1910 were defeated in three counties — Clackamas, Coos and Multnomah. Colorado, where a county “home rule” amendment to the constitution was defeated in 1902, has since established a “home rule” system under which four municipal referendums have come off — one in Denver, one in Colorado Springs and two in Pueblo. In Denver and Colorado Springs Singletax measures were defeated; in Pueblo one was carried in 1913 but repealed in 1914 before it had gone into practical operation. As early as 1895–96 the question was raised before the people of Delaware on a Singletax amendment to the constitution, but was defeated after an exciting campaign. The people of Missouri voted in 1912 on constitutional amendments establishing the Singletax by stages over a period of several years, and defeated them by an enormous majority, the favorable vote being 86,647 in a total of 594,784 throughout the State, and 47,583 in a total of 112,408 in the city of Saint Louis. Singletax referendums in Everett, State of Washington, have resulted favorably, but are as yet ineffective under constitutional objections. Tax Commissioner Pastoriza of Houston (Texas) made Singletax innovations by common local consent, as matter of arbitrary administration; and for fiscal purposes the system is to some extent in administrative operation in the State irrigation districts of California. The earliest distinctive Singletax experiment in the United States was begun at Hyattsville (Md.), a suburb of Washington, D. C. Taking advantage of a State law permitting municipalities to attract industrial enterprises by exempting them for a time from taxation, the Hyattsville council adopted the Singletax for local revenue purposes in 1892, but its action was abrogated by the State courts in 1893 as unconstitutional. Not long after the Hyattsville experiment a Singletax colony, or enclave, to be located in Alabama on Mobile Bay, was organized in Iowa. Out of its land values this enclave, known as Fairhope, has for nearly 25 years maintained itself and paid the general taxes levied upon its inhabitants. It is managed more in accordance with land nationalization than Singletax methods, but the principles and purposes of land nationalization and the Singletax are essentially the same. Another enclave, Arden, was established in Delaware in 1900. Since that time a third enclave, Halidon, has been located in Maine, and a fourth, Tahanto, in Massachusetts. There is also a fifth, Free Acres, in New Jersey. Under a “second class cities” law of Pennsylvania the Singletax has in limited degree been in operation in Pittsburgh and Scranton (the Pennsylvania cities of the “second class”) since 1912. Pursuant to this law, land is assessed for taxation at full value, while improvements are assessed at a descending ratio of their value, with the view of ultimately taxing improvement values only half as much as land values. A formidable movement for a similar local revenue law for the city of New York has been held in legislative check by opposition to it as a Singletax measure. In degree it is so, for if half the value of improvements were exempt, the whole value of land being taxable, the rest of the Singletax proposals, even to the extent of socializing all land values, would, in the phrasing of the Singletax agitation, be “only a matter of keeping on.” The Joseph Fels fund has been an important factor in the Singletax movement. Beginning in 1909, the late Joseph Fels devoted a large income, in addition to constant personal service, to Singletax propaganda in the United States, Great Britain, Germany, Denmark and Australasia. He died in 1914, but his widow, Mary Fels, has continued the donations and given her own personal services in place of his. In Great Britain the Fels contributions are administered through the United Committees for the Taxation of Land Values; in the United States through the Joseph Fels Fund Commission, the work of which is of national scope and fame.

For obvious reasons no attempt has been made to bring this historical outline down to a later date than about the beginning of the World War.

Bibliography.— Besides the Singletax books noted above, reference may be had to Post's ‘The Taxation of Land Values’ for an analytical presentation of the subject with illustrative diagrams and answers to typical questions; to Fillebrown's ‘A B C of Taxation’ for a conservatively favorable view; to Carver's ‘Essays in Social Justice’ and Hayes's ‘Introduction to the Study of Sociology,’ for moderate criticisms along with partial approval; to Nearing's ‘Income’ for a sympathetic consideration of intimately related economic and social phenomena; to Trowbridge's ‘Bisocialism’ for a technical exposition; and to Mathew's ‘Taxation and the Distribution of Wealth,’ Mallock's ‘Property and Progress’ (for uncompromising opposition), Thackeray's ‘The Land and the Community’ (historical), Dove's ‘The Theory of Human Progression,’ Hirsch's ‘Land Values Taxation in Practice’ (a comprehensive resumé to 1908); Hirsch's ‘Democracy versus Socialism’ (a scholarly contrast of Socialism and the Singletax); Hurd's ‘Principles of City Land Values,’ Post and Leubuscher's ‘George-Hewitt Campaign’ (includes controversial correspondence on the Singletax between Henry George and Abram S. Hewitt); Henry George, Jr's. ‘The Life of Henry George’; American Social Science Association's report of “The Singletax Discussion” at its meeting at Saratoga in 1890, and Henry George's ‘Property in Land’ (a controversy with the Duke of Argyle), and ‘The Land Question’ (originally written with special reference to land tenures in Ireland). Young's ‘History of the Single Tax Movement in the United States’ is a comprehensive and in all important respects a trustworthy narrative, and Miller's ‘Single Tax Year Book’ describes the progress of the movement extensively and in much detail from its beginnings in different parts of the world until about the opening of the World War.

Louis F. Post.

SINGLETON, Esther, American author: b. Baltimore, Md., 19th century. She lived in New York after 1897 and was for several years engaged in encyclopedia work. She later became known as a writer on a wide variety of topics, including music, art, literature and history. Author of ‘A Guide to the Opera’ (1899, 1909); ‘The Furniture of Our Forefathers’ (2 vols., 1900); ‘Famous Paintings’ (1902); ‘Social New York Under the Georges’ (1902); ‘Great Events of the World's History’ (5 vols., 1903); ‘Venice’ (1905); ‘Dutch and Flemish Furniture’ (1907); ‘Turkey and the Balkan States’ (1908); ‘Famous Cathedrals’ (1909); ‘How to Visit the Great Picture Galleries’ (1911); ‘Visit to English Cathedrals’ (1912); ‘American Historic Homes’ (1915); ‘Rodin and His Art’ (1918), etc.

SINHA, Sir Satyendra Prassano, K. C., first baron, Indian administrator: b. 1860. Born of humble native parentage in a village of Bengal, Sinha went to England in 1881 to study law at Lincoln's Inn. He was the first Indian to «take silk,» i.e., become a king's counsel, an honor hitherto confined to members of the bar practising in Great Britain. In 1909 Sinha became a member of the viceroy's executive council and was the first Indian to hold the office of advocate-general of Bengal. Together with the Indian Maharaja of Bikaner he represented India in the Imperial War Conference and in the War Cabinet, 1917–18, and also at the Peace Conference in Paris. On the formation of the new British ministry in January 1919, Sir S. P. Sinha was appointed under-secretary of state for India and a privy councillor, and raised to the peerage in order to represent the India Office in the House of Lords.

SINIGAGLIA, sē-nē̆-gä'lyą, **Leone,** Italian composer: b. Turin, 14 Aug. 1868. He studied under Bolzoni in Turin and later under Mandyczewsky in Vienna, where he received much assistance from associating with musicians such as Dvořák and Goldmark. Among his compositions are many violin and violincello pieces, songs and female choruses; a set of variations on Schubert's ‘Haidenröslein’ for oboe and piano; violin concerto in A; ‘Rapsodia piedmontese’ for violin and ochestra; Romance in A for violin and orchestra, etc.

SINJIRLI, sĭn-jėr'lē, Asiatic Turkey, a village in the vilayet of Aleppo, at the foot of Mount Amanus or Giaour Dagh, 30 miles northeast of Alexandretta, ancient Iskanderun, on the Mediterranean. It is noted as the site of an ancient Hittite city, excavated under the auspices of the German Orient-Gesellschaft since 1888. The two encircling city walls and the acropolis with three lines of fortifications were disclosed, and numerous Aramaic inscriptions of great historical value were discovered. One of the most important finds, now in the Berlin Museum, was an inscribed stele, or stem of an arrow, commemorating the victory of Esarhaddon, king of Assyria, in Tammuz (June) 670 B.C., over Tirhakah, king of the Egyptians, who is represented as a negro. Consult Lidzbarski, ‘Nordsemitische. Epigraphik’ (1898); Müller, *The Contemporary Review* (1894).

SINK HOLES, depressions due to solution of an underlying soluble rock layer, such as limestone, gypsum or salt. Sometimes they are formed by the enlargement of a joint in limestone, with the consequent slump of the overlying soil, forming a nearly circular funnel-shaped depression of small size. Larger sinks, often with steep sides, are caused by the collapse of the roof of a cave. Sinks several miles in diameter and over a hundred feet deep are common in the Ozark Region and in Kentucky. Streams often flow into sink holes and disappear, continuing as underground rivers and emerging as very large springs at some lower point. If the underground outlet becomes blocked a sink often becomes the site of a lake. Such was the origin of Alachua Lake in Florida, a body of water over eight miles long, on which steamers at one time plied. The outlet finally opened up again and the lake became drained. Sink holes are also known as swallow holes, and are not to be confused with pot holes and kettle holes (qq.v.).

SINKING FUND. See Debts, Public; National Debts of the World.

SINN FEIN (shin fane, «ourselves»), an Irish party founded about 1905, whose policy may be described as at once the most extreme and the most moderate form of Nationalism. It is the most moderate because it aims at uniting Irishmen of all creeds and classes on a common platform, or a progressive series of common platforms, for Irish ends. The party, or movement as it has been termed, aims at the encouragement and support of the industries and the institutions of Ireland, and the revival of the Gaelic tongue as a medium of intercourse among the people of Ireland. Its policy has been summed up by one of its founders as «national self-development through the recognition of the duties and rights of citizenship on the part of the individual, and by the aid and support of all movements originating from within Ireland, instinct with national tradition, and not looking outside Ireland for the accomplishments of their aims.» Sinn Fein is simply, then, the Gaelic for «ourselves,» which, after all, is the working motto of every government and corporation in the modern world. Trusts and tariffs are Sinn Fein applied to the industrial world. The workings of empires and chosen peoples are pure Sinn Fein. The Sinn Fein party regards Ireland as being of right a distinct nation and believes in establishing «in Ireland's capital a national legislature endowed with the moral authority of the Irish nation.» For the first 10 years of its life the party's policy was one of passive resistance, as a substitute for physical force, and this has meant, in substance, the laying of a boycott on everything English; the economic reorganization of Ireland by its own people, on a purely Irish basis; the non-recognition of English-made laws; and the non-support of English institutions in Ireland. It says in effect to the people of Ireland: «Buy Irish goods because they are not English, and, if you cannot get Irish goods, buy French or German or American goods, or indeed any goods rather than English. Do so as long as England refuses to keep the terms of the Renunciation Act of 1783, in which she laid it down ‘that the right claimed by the people of Ireland to be bound only by laws enacted by His Majesty and the Parliament of that Kingdom is hereby declared to be established, and ascertained for ever, and shall at no time hereafter be questioned or questionable.’» Such is the message of Sinn Fein, considering the industrial revival as a political weapon.

Sinn Fein recognizes in nationality something much more wonderful and even necessary than politics. It holds, however, that nationality must have its political phase and expression, and that no nation ever yet became exuberantly itself, exuberantly a thing of beauty and use in the family of nations, unless it was politically free. Its aim as a political organization is consequently the independence of Ireland, and as a means to that end it proposes the destruction of the machinery of foreign government in Ireland. Not that it is principally a destructive or war policy. Nationalists are anxious for peace, according to Mr. Arthur Griffith, the political thinker of genius who edits *Sinn Fein*, the party organ, and who originated the Sinn Fein policy in the columns of the *United Irishman*, but before terms of peace can be discussed, he continues, in a phrase reminiscent of John Mitchel, "England must take her one hand away from Ireland's throat, and her other hand out of Ireland's pocket." In other words, let England observe the terms by which she bound herself in the Renunciation Act of 1783, as quoted above. Thus far we have stated in this article what may be termed the official attitude of Sinn Fein during the first decade of its existence. In its second decade the movement appears to put very little trust in legal and constitutional arguments, and claims Ireland's right to be a separate and free nation as a right given by God, without troubling about its other aspect as a right confirmed by England. All Sinn Feiners are agreed to work on a common platform for the independence of Ireland, the minimum interpretation of Independence being that which is laid down in the Constitution of 1782 and the Renunciation Act of 1783. Ireland, it declares, must no longer send representatives to the British Parliament to plead to indifferent ears the cause of Irish freedom, since to do so is not only useless in practice, but is an apparent acquiescence in the terms of the Act of Union. Moreover, it holds that for Irishmen to attend in a foreign Parliament and to take an oath of allegiance to a king, who is no longer the head of a free Irish constitution, but a symbol of foreign conquest, is a lie and an act of national dishonor. Irish politics, according to the Sinn Fein ideal, must not be allowed to rest on a national falsehood, which in the 19th century did so much to corrupt and confuse the political thought of the country, but must be placed on the far securer base of truth and honor and reason. The movement stands for the building up of truly Irish industries, with the production in Ireland of whatever articles Ireland might need, and the stimulation of foreign commerce; to this end Sinn Fein urges the establishment of an Irish merchant marine and an Irish consular service to encourage foreign trade. It advocates also the creation of an Irish civil service, of Irish national courts of law, an Irish national stock exchange, Irish national banks, and the like— all these to be popular Irish institutions, completely independent of England. It is one of the objects of Sinn Fein to give the brains and muscle of the country scope and happiness in the service of Ireland. Sinn Fein thus proposes to build up the Irish nation. It has set about organizing a great national passive resistance movement to oppose the British government and British influence at every point of vantage they have gained in the country — fiscal, educational, industrial, legal, literary, dramatic, artistic. Ireland, it says, has too long met England on battlefields which England herself has chosen — the floor of the House of Commons and the field of war. Let Ireland now choose the place of battle and let it be the Irish school, the Irish factory, the Irish shop, the Irish home, the Irish farm, the Irish church, the Irish theatre, and Sinn Feiners have no doubt that a new and beautiful individuality will be added to the family of nations. Prominence has been given to the aims and professions of Sinn Fein as a school of nationalism with which the future will have to reckon. It aims at building a nation to include all the races and creeds and ranks that inhabit Ireland. It answers the argument that Ireland is too small and too poor to be an independent nation by pointing to such nations as Switzerland, Denmark, Greece, Sweden, Norway, Rumania of less area, population and revenue.

COUNTRY	Taxation per head
Denmark	$8.25
Württemberg	7.13
Greece	5.87
Rumania	5.98
Sweden	8.37
Norway	8.11
Switzerland	6.87
Ireland	11.03

Sinn Fein certainly has brought intellect, imagination and constructive ideas into Irish politics to a degree unparalleled since the days of the Young Irelanders of 1848. It remains to be stated here that the Rebellion of April 1916 was not entirely the work of the Sinn Fein party but the result of the continued preaching of the Fenian doctrines. Up to 1916 Sinn Fein had put forward only one candidate for an Irish constituency and he was overwhelmingly defeated. The Irish question was shelved for a time by the British Cabinet. On 27 April 1917 Lloyd George proposed an Irish convention to settle the Irish question, promising that if there developed a substantial majority for Home Rule within the convention his government would legalize the recommendations of that majority. After a year of discussion a plan of Home Rule was adopted and agreed upon by all but 19 Ulster Unionists, and an April 1918 Lloyd George held that the 19 dissenting votes out of 100 showed a lack of substantial agreement and stated that Ireland's case would thereafter be treated as a purely British question. On 17 May 1918 Dublin Castle (the centre of the English bureaucracy in Ireland) issued a proclamation declaring the discovery of a vast German plot. Eamonn De Valera, Arthur Griffith and numbers of prominent Sinn Feiners were arrested and sent to England to be confined "during the King's pleasure." When several days passed without either arraignment or trial of any of the prisoners, a general demand arose that the government disclose some proof of the alleged German-Sinn Fein plot. Although the Labor party, many Liberals and the Irish Nationalists, and the press demanded that evidence of the plot be produced, the government remained silent. In this connection, nothing is more significant than the statement of Lord Wimbourne, former Lord-Lieutenant of Ireland, that throughout his régime he had discovered no sign of the alleged plot and asserting his belief that *satisfactory evidence of its existence could not be produced*. The Sinn Feiners, men and women, were confined in England until March 1919 without arraignment, without the production of one single piece of evidence against them and were denied the right of counsel. By the end of June 1918 Conscription and Home Rule measures were formally abandoned, and the government in Ireland ran its course to the elections of December 1918. The Sinn Fein party went before the electorate on the definite proposition of an independent Irish republic, and the total separation of Ireland from the political system known as the British Empire. At the polls the Sinn Fein victory was overwhelming. Out of 32 counties its candidates ran unopposed in 22. In Ulster it carried Donegal, Monaghan and Cavan, and won majorities in Fermanagh and Tyrone, carried a seat in Derry City, the supposed stronghold of Unionism. It lost only in Down, Derry, Armagh and Antrim. Of 101 members the Sinn Fein elected 73, the Nationalists seven and the Unionists 21. With this mandate from seven-tenths of the people of Ireland, the Sinn Feiners proceeded to organize their Irish Parliament. On 21 Jan. 1919 the Dáil Eireann (Irish Parliament) met in Dublin and called upon the free nations of the world to support the Irish republic by recognizing Ireland's national status. Eamonn De Valera was chosen President of the Irish republic. He, with Arthur Griffith and Count Plunkett, were named commissioners to the Peace Conference at Paris. Passports being denied them, three Irish-Americans interceded in their behalf with the American delegates at Paris but without result. The three Irish-Americans, however, Messrs. Dunne, Ryan and Walsh, were permitted by the British government to visit Ireland. They reported that they found conditions «appalling.» Men were herded in filthy, unsanitary prison dungeons, were compelled to sleep in clothes drenched with cold water, were compelled to attend divine service with hands fastened behind their backs, etc., etc. The publication of the report called forth much discussion, vigorous denials and as vigorous demands for investigation. After a delay of two weeks the Chief Secretary for Ireland made his reply to the charges in Parliament, explaining or denouncing the findings of the report, but its authors insisted upon its truthfulness, and that an impartial committee should be appointed to pass upon the facts of which they had authentic evidence. In 1919 De Valera made a lecture tour in the United States explaining the purposes and aims of the Sinn Fein.

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J. B. McDonnell,
Editoral Staff of The Americana.

SINNETT, Alfred Percy, English journalist and theosophist: b. 18 Jan. 1840. After study at the London University School, he became connected (1859) with the *Globe* newspaper, later was sub-editor and «leader» writer for various dailies in London, and in 1865–68 was at Hongkong, as editor of the *Press*. On his return he became an editor of the *Standard*, took editorial charge of the *Pioneer of India*, and becoming identified with the Theosophical movement, was made president of the London branch of the society, and wrote: 'The Occult World' (1881); 'Esoteric Buddhism' (1883); 'The Growth of the Soul' (1896). He edited *Broad Views* from 1904 to 1907. A play by him, 'Married by Degrees' was produced (1911) in London.

SINON, a character in the Trojan war-story of post-Homeric origin. According to Virgil, he was a follower of Ulysses, allowed himself to be taken prisoner by the Trojans, and persuaded them to drag the colossal wooden horse into their city. Within this structure were concealed all the leading warriors of the Greek army. The night following the admission of the horse, Sinon gave the signal to the besiegers, by lighting a beacon, released the heroes from the horse, in which they were imprisoned, and thus brought about the sack of Troy.

SINOPE, sĭ-nō'pē (Turkish, Sinúb), Asiatic Turkey, a seaport city, capital of a sanjak, situated on the neck of land connecting the rocky peninsula of Cape Sinope, in the Black Sea, with the mainland, 350 miles east-northeast of Constantinople. It is enclosed by a wall flanked with towers and defended by a castle and several forts, and is built to a considerable extent out of the ruins of an ancient Greek city. Its harbor is the best on the south shores of the Black Sea, and it has a naval arsenal and a shipyard, at which many vessels are built. On 30 Nov. 1853, 18 Russian ships here attacked and destroyed a Turkish flotilla consisting of six frigates, three corvettes and two steamers, manned by about 4,000 men. Sinope is a place of great antiquity. It was the birthplace of Diogenes and the capital of Mithridates the Great. Pop. about 9,000.

SINTER. See Geyserite, Calc-tufa, and Tufa.

SINÚB, sē-noob'. See Sinope.

SINUS, *in anatomy,* a cavity of bone or other tissue, especially an air cavity of some size, such as those in the interior of certain bones, the frontal, ethmoid, sphenoid, temporal, superior maxillary, etc. The frontal sinuses are two irregular cavities extending upward and outward from their openings on each side of the nasal spine, between the inner and outer tables of the skull, and separated from one another by a thin bony septum. They give rise to the prominences above the root of the nose called the superciliary ridges. They are not fully developed till after puberty, and vary considerably in size, being usually larger in men than in women and young persons. When very much developed they give a receding appearance to the forehead. They communicate on each side of the upper part of the nostril by a funnel-shaped opening, which transmits a prolongation of mucous membrane to line their interior. These sinuses are much more highly developed in certain mammals and birds than in man: They extend backward over the top of the skull in the ruminant and some other quadrupeds, and penetrate the cores of the horns in oxen, sheep and a few antelopes. The most remarkable development of air sinuses in the mammalian class is presented by the elephant; the intellectual physiognomy of this huge quadruped being caused, as in the owl, not by the actual capacity of the brain case, but by the enormous extent of the pneumatic cellular structure between the outer and inner plates of the skull. The sphenoidal sinuses are two large irregular cavities, formed, after the period of childhood, in the body of the sphenoid bone. They communicate with the upper part of the nose, from which they receive a layer of mucous membrane. Like the frontal sinuses, they serve to lessen the weight of the skull and to add to the resonance of the voice. The ethmoid sinuses lie in the lateral masses of the ethmoid bone. They communicate with the cavities of the nose. Their main use is to diminish the weight of the fore part of the skull. That part of the temporal bone which forms the projection behind the ear is termed the mastoid process. The interior of this process is hollowed out with air sinuses which communicate with the tympanum or middle ear, and through it with the nose. The superior maxillary sinus is the largest of the sinuses, and the only one present in the infantile skull. The term sinus is also applied to irregular channels for the transmission of venous blood.

SION. See Zion.

SIOUAN, soo'ăn, a designation derived from the word «Sioux,» and applied to the linguistic stock or family to which the Sioux Indians belong. The Sioux call themselves Dakota, or Lakota, and the name «Sioux,» given to them by the whites, is said to be derived from an Algonquin word signifying the «snake-like ones,» or enemies, a term which their crafty methods of warfare would seem to justify. The family of tribes, of which the Sioux are the best known to Americans of the present day, includes, as principal divisions, the Dakotas or Sioux in the United States, and the Assiniboins in British North America, although both Sioux and Assiniboins occasionally cross the border into adjoining territory. The Sioux division embraces the sub-tribes of Santee, Sisseton, Wahpeton, Yankton, Yanktonnai and Teton, and the last mentioned, whose name means «dwellers on the prairie,» are again subdivided into the Brulé Sioux, the Sans Arcs, Blackfeet, Ogalalla, Minneconjou, Onopaw and Unkpapa. To the Sioux nation also belong or belonged the sub-tribes of Omaha, Quapaw or Arkansa, Ponca, Osage and Kansa, Iowa, Oto and Missouri; also Winnebago, Mandan, Minnetaree or Gros Ventres (which last named includes the Crow Indians), Tutelo, Biloxi, Catawba (or Flathead), Eutaw, Chickoree, Natchez and others, and the Mannahoak, Monacau and other tribes, which came into contact with the pioneers of Virginia and North and South Carolina, and are now extinct or represented by insignificant remnants.

The Siouan tribes of the East which were not crushed out in conflict with the early settlers retreated gradually to the Northwest, and made their final stand in that region against advancing civilization. The battle known as the Custer (q.v.) massacre (25 June 1876) was the last important military event of the long conflict, and it was followed by such energetic measures on the part of the United States that organized resistance by the Sioux to the National authority was finally terminated. Sitting Bull (q.v.), the last of the great Indian chieftains who rose above the level of marauders, and were actuated by a sincerely patriotic spirit in their resistance to white aggression, was killed on 15 Dec. 1890 when his arrest by government agents was resisted with an attempted rescue. See Indians, American.

SIOUX (soo) **CITY,** Iowa, county-seat of Woodbury County, on the Missouri River at the mouth of the Big Sioux, and on the Chicago and Northwestern; Chicago, Minneapolis and Saint Paul; Illinois Central; Chicago, Milwaukee, Saint Paul and Omaha; Chicago, Burlington and Quincy, and Great Northern Railways, 18 lines of these six systems radiating in every direction. It has steamer connection with the Missouri River ports and trolley connection with suburban villages. It is the commercial, industrial and livestock centre of western Iowa, northern Nebraska, most of South Dakota and southwestern Minnesota. The residence portions are on high, rolling ground, much of which overlooks the valleys of the Missouri and Floyd rivers, the latter stream flowing through the city. Sioux City was first settled in 1849 and for many years was the outfitting point of all the traffic to the Black Hills, as well as headquarters for the troops engaged in various campaigns against the Indians. Its first railway was the Northwestern, reaching the city in 1868. In earlier years Sioux City attained much fame through its «Corn Palaces,» this annual entertainment being abandoned when the Interstate Live Stock Fair was organized, of which institution it is claimed that it is the largest fair in the United States with neither State nor Federal aid. The government census of 1918 gives 350 manufacturing establishments, with invested capital to the amount of $46,000,000. There were employed in the factories 8,500 persons, whose annual wages amounted to $9,800,000; the raw material cost was $40,819,000, and the annual value of products was $85,000,000. Chief among Sioux City's industries are its six large packing houses, consuming the major portion of the livestock receipts of the sixth largest market in the United States. Other industrial establishments are brick and tile plants, flour and cereal mills, planing mills, soap factories, furniture factories, foundries, steel and iron works, truck and tire factories, stock equipment factories, stock serum plants, overalls, shirt and skirt factories, tent and awning factories and creameries producing 12,000,000 pounds of butter annually. Its grain concerns handled more than 50,000,000 bushels of corn, wheat and other cereals in 1918. Sioux City is also a large jobbing centre, its 80 wholesale houses doing a business of approximately $150,000,000 annually in Iowa, Minnesota, Nebraska, South Dakota, North Dakota, Wyoming and Montana. The principal public buildings are the Federal building for the enlargement of which an appropriation of $335,000 was secured in 1915; the Union Station, cost $600,000; Y. M. C. A. building, $120,000; public library, $100,000; City Hall, $80,000; Court House, $750,000; the Davidson and the Francis office buildings, costing $400,000 each; Davidson's Grain Exchange building; High School, $550,000; two Junior High School buildings;

Saint Joseph's, Samaritan, Saint John's, German Lutheran and Saint Vincent's hospitals. The waterworks, costing $1,250,000, are owned by the municipality; it is debt free and pays an annual profit, which is put back into extensions. The city has 75 miles of concrete paving, with 40 miles of asphalt and block. Sioux City has a public park system of nearly 2,000 acres, the largest being Stone park (800 acres) and Riverside park (575 acres), both located along the Big Sioux River. The latter contains the grave of War Eagle, most famous of all the Sioux chieftains. Floyd park surrounds a massive and beautiful monument to Sergeant Charles Floyd, a member of the Lewis and Clarke expedition, who died there in 1805. The educational institutions, other than a most complete public school system, are Morningside College (Methodist), opened in 1890; Trinity College for boys (Catholic), founded in 1912; the National Business Training School and several parochial schools. The 18 banks have a combined capital of $3,330,000 with deposits aggregating $46,913,000. Sioux City is the natural centre of a vast and famous agricultural section, the 100 counties nearest to the city in Iowa, Nebraska and South Dakota producing nearly $600,000,000 in crops and livestock annually, as against $250,000,000 for all the New England States combined, according to the last Federal census. Population (1890) 37,806; (1900), 33,111; (1910), 47,828; (1915), 61,787; (1919), 80,000 (estimated).

SIOUX FALLS, S. Dak., city, county-seat of Minnehaha County; on the Sioux River, and on the Chicago, Milwaukee and Saint Paul and the Chicago, Saint Paul, Minneapolis and Omaha, the Illinois Central, the Rock Island, Watertown and Sioux Falls and the Great Northern railroads, about eight miles from the Iowa boundary. It was settled in 1856 by the Western Iowa Company of Dubuque, Iowa, but was abandoned the next year. Soon afterward the place was again settled by eastern homeseekers. It was organized as a village in 1877 and chartered as a city in 1883. In the vicinity are extensive quarries of marble, jasper and other stones. The river here has a fall of about 100 feet in a half mile, forming a series of cascades which furnish extensive water power. The city is located in the midst of a rich agricultural community; corn, small grain, hay, livestock and dairy products being the principal sources of wealth. The chief industries are meat packing, manufacture of confectionery, metal culverts, grain bins, sash and cabinet work, crackers, brick, paper boxes, plows and harrows, soft drinks, soap, acetylene gas outfits, cigars, building-stone, paving-blocks and crushed rock from the quarries. Three creameries make a great quantity of butter and have built up a good cream, egg and poultry market. Some 4,000 people are employed in manufacturing exclusively, turning out products valued in excess of $20,000,000. The city is a strong wholesale and jobbing centre, being especially favorable for the distribution of agricultural implements and vehicles. Sioux Falls is not only the commercial and industrial centre of South Dakota, but enjoys a good trade in southwestern Minnesota and northwestern Iowa. The principal buildings are the State penitentiary, State School for the Deaf and Dumb, State Children's Home, County Courthouse, Coliseum, municipal buildings and the 30 churches, which include a Roman Catholic and Protestant Episcopal cathedral. The public school system is one of the best in the country, the newer grade schools being of advanced type of construction, built on the one-story, community centre plan. Among the higher institutions of learning are All Saints School for Girls, the Lutheran Normal School and Sioux Falls College. The eight banks have a combined capital of $925,000. The government is vested in a three-man commission elected for a period of five years, one of the commissioners acting as mayor at a salary of $3,000 per year, and the other two commissioners at $2,000 per year each. Pop. 32,000.

SIPHON, a bent pipe having the ends approximately parallel so that when the short end is sunk in a liquid, the bend may carry the pipe over the higher edge of the containing vessel and the long end of the pipe being then positioned lower than the short end, the liquid may be drained off by gravity, once the flow is started. The reason for this is that when the air is sucked from such siphon the liquid flows in and the larger end containing the greatest weight of liquid starts a flow. The fluid has to rise in the short end or there would be a vacuum. The siphon will not raise water more than 32 feet, because then the weight of water equals the atmospheric pressure. If there were no weight of atmosphere the phenomenon would not occur. A siphon has to be of moderate diameter, else the suction does not operate fully. A considerably depressed series of piping in a water main is sometimes termed an inverted siphon as where the Catskill aqueduct passes under the Hudson River.

SIPHONOPHORA, an order of free-swimming polpys (*Hydrosoa*). All are remarkable as forming colonies of zooids, which become differentiated as organs of special function, and altogether lose their separate individuality. They present the most noteworthy instances of polymorphic colonies known to zoology and differ greatly in complexity. In the most complex cases the zooids or polyp organs may be divided into about seven types, each differing in form and function but retaining the fundamental polyp structure. These are: (1) pneumatophores or floats; (2) nectocalyces or swimming bells, whose function is to propel the colony; (3) gastrozooids, or nutritive polyps, which feed the colony; (4) hydrophyllia, leaf-like protective polyps; (5 and 6) dactylozooids and tentaculæ, offensive polyps armed with numerous stinging cells; (7) gonozooids or reproductive polyps of different types. The siphonorphores are delicate transparent animals often beautifully colored, and they abound in the Gulf Stream and other warm oceanic waters. A familiar example is the Portuguese man-of war (*Physalia*). Consult Haeckel, ‹Challenger Reports› (Vol. XXVIII London 1888).

SIPPAR, sĭp-pär′, **SIPPARA, SEPHARVAIM**, or **ZIMBIR**, ancient Babylonian city, on the Euphrates and north of Babylon. It was originally two cities, divided by a canal and designated Sippar and Agade. In time, however, the name Agade was lost, but the division remained, one part of the city being the Sippar of Shamash, the Sun God, and the other the Sippar of the goddess Annuit. The Old Testament name for it is Sepharvaim. The records of the antediluvian world are supposed to have been buried here by the Chaldean Noah. The temple of Shamash was discovered by Hormuzd Rassam in 1881, by whom extensive excavations were made, and who brought to light nearly 60,000 inscribed tablets. Consult Hormuzd Rassam, 'Babylonian Cities' (1881); and 'Asshur and the Land of Nimrod' (1897); Scheil, V., 'Mémoires Français d'Archæologie Orientale de l'Institut de Caire' (1902).

SIQUIJOR, sē-kē-hôr', Philippines, (1) Pueblo, island of Siquijor, province of Bohol, on the northwest coast of the island. It has a good harbor and is the chief port and principal town of the island. Pop. 11,790. (2) Island, the second in importance of the province of Bohol, lying southwest of the island of Bohol, and east of Negros; length from east to west, 17 miles; width 12 miles, area, 126 square miles. The surface is much broken, rising to a central peak, 1,394 feet high. The soil is fertile; tobacco of excellent quality, rice, corn, hemp and chocolate are raised and bartered for wax and cotton; a coarse variety of hemp cloth is manufactured for export; tortoise shell and sea cucumbers (bèche de mer) are gathered in large quantities. Pop. 46,023.

SIR, a term of courtesy, applied without distinction of rank, to all male adults, used especially in the form "Dear Sir," in opening a letter. It is also the special title in Great Britain of knights and baronets, and as such is always prefixed to the Christian name. *Sire* is a term of respect by which kings are addressed. The word *sir* is the same in origin as *sire*, and is derived from old French *senre*, and that from *senior* (Latin, elder), whence also *seignior, signor*, similar terms of courtesy.

SIR DARIA, sēr-där'yä, Russian Turkestan. See SYR DARYA.

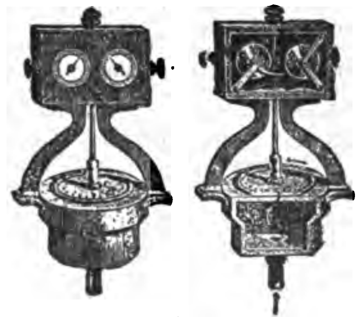
SIR GAWAIN AND THE GREEN KNIGHT, generally regarded as the finest of the metrical romances in Middle English. It is usually held to be the work of the author of 'The Pearl' (q.v.), though absolute proof of this is impossible. It was written in the West Midland dialect about 1370, in an elaborate stanzaic form, employing both alliteration and rhyme. The same highly-wrought artistry appears in the narrative, with its wealth of description and detail. These elements are, however, subordinate to a carefully considered plot, which is in brief as follows: A strange knight clad all in green bursts into Arthur's hall at Camelot, and challenges any knight to strike him with the battle-axe, the blow to be returned by the challenger a year later. Gawain accepts, and severs the champion's head at a blow. After picking up his head, which reminds Gawain of the coming meeting at the Green Chapel, the knight rides away. A year passes. Gawain, on his way to the Green Chapel, is splendidly entertained in a magnificent castle. On three successive days the lady of the castle offers her love, but Gawain acts with scrupulous honor toward his host, concealing nothing from him save a lace given him on the third day, which is to afford protection in combat. At the meeting with the Green Knight, Gawain gets only a slight wound the third time that the axe is raised. The knight thereupon reveals himself as the lord of the castle, and the third blow as a punishment for the keeping of the lace on the third day. The whole episode was a test, instituted by Morgan the Fay, who wished to test the knights of Arthur and frighten Guinevere. Gawain returns to the court, where all the warriors agree to wear a green girdle, in remembrance of the adventure.

The immediate source of the poem was undoubtedly a French romance now lost. The different elements in the plot are admirably traced by Kittredge in 'A Study of Sir Gawain and the Green Knight' (Cambridge 1916). The whole has been translated, in the original metre, by Miss J. L. Weston, 'Romance, Vision and Satire' (Boston 1912).

WILLIAM WITHERLE LAWRENCE.

SIRAJGANJ, sē-räj-gŭnj', or **SERAJGANJ**, India, a town in the district of Pabna, Bengal, on the Jamuna River, 153 miles northeast of Calcutta. The town is six miles from the low water channel of the river, separated by a sandy plain and the river landing-places shift every flood season. Founded about the beginning of the 19th century, it is now one of the chief river marts in Bengal, having risen with the growth of the jute trade. It collects jute, rice, oil-seeds, tobacco, etc., from all the neighboring districts for dispatch to Calcutta and distributes piecegoods, salt, sugar, iron, hardware, etc. The trade is entirely water-borne, 150,000 tons of jute being exported annually. A large industry is the weaving of gunny, or jute cloth for bags, which is exported to the value of $600,000 a year. Pop. about 25,000.

SIREN, (1) *in zoology*, the mud-eel (*Siren lacertina*), having a mouth very beaklike, with a few rasplike teeth and tufted gills. It is found in the bayous of the Carolinas, Florida and Texas. (2) A mechanism for producing continuous or musical sounds, and for measuring the number of sound-waves or vibrations per second, which produce a note of given pitch. In its original form it consists of a disc with a circular row of oblique holes, revolving close to the top-plate of a wind-chest perforated with corresponding holes of a contrary obliquity, so that the jets of air from the latter passing through the former keep the disc in motion and produce a note corresponding to the rapidity of the coincidences of the holes in the two plates,


Siren.

the number of coincidences or vibrations in a given time being shown by indices which connect by toothed wheels with a screw on the axis of the disc. For steam-siren see FOG-SIGNALS.

SIRENIA, an order of aquatic herbivorous mammals, with almost hairless skin, no hind limbs, the tail flattened horizontally and two teats situated on the chest. The unborn young are covered with a thick fur; and many points of dentition, structure and life history show affinity to the ungulate land mammals. There is much less relationship to the *Cetacea* within which this group was formerly classified. The order embraces but three recent genera, *Manatus, Halicore* and *Rhytina,* the latter now extinct, representing as many families. Besides these a number of fossil genera are known. *Halitherium* occurs in Miocene and Pliocene formations; it was of large size, and appears to have been somewhat intermediate in structure between the two living genera and to have possessed rudimentary hind limbs. Consut Brandt, 'Symbolæ Sirenologicæ' (Saint Petersburg 1868); Woodward, 'Vertebrate Paleontology' (Cambridge 1898). See DUGONG; MANATEE; SEA-COW.

SIRENIDÆ. A family of large newts characterized by three pairs of persistent external gills, the absence of any trace of hind-legs, eyelids or maxillary bones, and of teeth in the jaws (which are covered by horny sheaths). Teeth are found, however, on the vomer. The family is closely related to the *Proteidæ* (q.v.). It contains two genera, of one species each, both inhabiting the Southeastern States. These are *Siren* and *Pseudobranchus.* In *Siren* there are three gill-clefts on each side and four fingers, and the gills atrophy in the course of development, being subsequently regenerated. In the adult *Pseudobranchus* the gills are functionless and there are only three fingers on each hand, and one pair of gill slits. *Siren* grows up to the length of 30 inches. See AMPHIBIA; URODELA.

SIRENS, *in Greek mythology,* the name of several sea-nymphs, who by their singing fascinated and later destroyed those who approached their locality which was the sea between the island of Circe and Scylla (q.v.). When Ulysses approached Circe, which was near the northeast coast of Sicily, he stuffed the ears of his companions with wax, while he bound himself to the mast, and so they escaped. The Sirens then threw themselves into the sea, where they became formidable rocks.

SIRIUS, sĭr'ĭ-ŭs, *in astronomy,* the brightest star in the heavens, also called the Dog-star, situated in the mouth of the constellation Canis Major. Its magnitude is 1.6, and its distance 8.8 light years. In 1862 it was proved by Alvan G. Clark to be binary, which was believed because of disturbances of its proper motion. The companion star is almost a satellite, being of 10th magnitude, that is rendering about 1 to 21,000 of Sirius light. They revolve in 51 years. See ASTRONOMY.

SIROCCO, a hot, relaxing and oppressive southeast wind, which blows in Sicily and South Italy. While it continues the atmosphere is obscured by a haze and so great is the languor it occasions that few persons quit their houses. It is supposed to be the same as the simoom (q.v.), tempered by its passage across the water.

SIRVENTE, sĭr-vŏṅt, a form of recited verse common among the Troubadours and Trouverses. These songs were originally devoted to love, war, praise, etc., and divided into strophes of a peculiar construction. Later they degenerated into satire and reflections on political abuses.

SISAL HEMP, *Agave fourcroyoides* and *sisalana.* The growing plants resemble the century plant, though the leaves are more slender and spear-like; they measure three and one-half to five feet long, and four to five inches wide, the general average being four to four and one-half inches. The product is a structural fibre derived from the older leaves, the first cuttings for fibre being made when the plants are five years old from the date of setting out in the field. The filament is yellowish white, straight, smooth and clean, sisal ranking second to manilla in value as a cordage fibre. It is a native of Yucatan, which furnishes the bulk of the world's supply, and the Bahamas, and very recently Hawaii has contributed a little. It is found (introduced) in many parts of Mexico proper, throughout the West Indies and in Central and South America. It was introduced into Florida by Perrine, in 1836, and into the Bahamas by Nesbit, in 1845, Yucatan plants being used, and into Hawaii, from Florida, in 1893. The growth of the plant, experimental or otherwise, has been extended to many parts of the world, commercial cultivation having been attempted in India and on the west coast of Africa.

The commercial supply of the United States is derived mainly from Yucatan. In Florida the plants are found growing semi-wild in small tracts, both on the keys and the east and west coasts of the mainland. Small attempts have been made from time to time to establish an industry, but it is doubtful if the culture could be made to pay in Florida, especially in competition with the vast sisal hemp farms of Yucatan. The Yucatan industry is centred at Merida, 20 miles south of Progreso, the port of shipment. On the larger farms systems of miniature railways are laid down for the transportation of the bundles of cut leaves from the fields to the central factories, where the cleaning or scraping process is effected by powerful machines. The operation consists merely of removing the epidermis and soft cellular tissue, which leaves the fibre clean and white; it is then dried in the sun and baled for market. Sisal hemp and manila hemp make up the bulk of the hard fibre used for cordage in the United States, the larger portion of the sisal going into binder twine for binding the grain crop, though considerable rope is made from it for inland use.

Consult Special Reports (Nos. 1 and 5); Fibre Investigations, Department of Agriculture; 'Scientific American Supplement' (No. 1,837, 2 Aug. 1902); Bulletins Royal Gardens, Kew; Bulletin (No. 4) Hawaiian Agricultural Experiment Station, Honolulu; and James M. Rae, 'Report on the Fibre Industry of the Bahamas' (Nassau 1891). See BAHAMAS; CORDAGE; FIBRE; HEMP; YUCATAN.

SISCOWET. See Lake Trout.

SISKIN, a European finch (*Carduelis spinus*), of the *Fringillidæ*, greenish in general color, with dusky and yellowish markings and the under surface whitish. These birds are usually seen in small flocks, haunting the margins of streams, and are much sought after by bird catchers, and when interbred with the canary produce a hybrid progeny with a sweet mellow song. A very similar Canadian bird is known as the pinesiskin; and the name is sometimes given to the goldfinch. See Finch.

SISLEY, sĭs-lĭ, **Alfred**, French painter: b. Paris, about 1830; d. 1899. He was little known except as a promising pupil of Gleyre, until the Impressionists held their exhibition in 1874, when his boldness and originality were acknowledged. His indebtedness to Corot and even more so to Monet is apparent in all the landscapes which he produced, characterized as these are by poetic charm and remarkable freshness and frankness in color and detail. Among his works may be mentioned 'La Seine à Saint Mammès' and 'L'Inondation, Marly' (1876).

SISMONDI, sĭs-mŏn'dĭ (Fr. sēs-mŏṅ-dē), **Jean Charles Léonard Simonde de**, Swiss historian and political economist: b. Geneva, 9 May 1773; d. near there, 25 June 1842. He had scarcely completed a careful education at the College and the Auditoire of Geneva when the overthrow of the constitution of his native town obliged him to flee with his father to England. On his return, two years after, he was imprisoned and lost the greater part of his property by confiscation. Similar persecution followed him even in Tuscany, whither he proceeded in 1795 and where he was hated by the French as an aristocrat and by the Italians as a Frenchman; but at length, on his return to Geneva in 1800 he was allowed to live in quietness and devote himself with the utmost diligence to literary pursuits without declining to bear his part in the discharge of municipal functions. His first published work appeared in 1801 and was entitled 'Tableau de l'Agriculture Toscane.' It discards all appearance of theory and abounds in practical details. In 1803 he published a work entitled 'De la Richesse Commerciale, ou Principes d'Economie Politique appliqué à la Législation du Commerce.' This essay was afterward remodeled so as to form the groundwork of his treatise published in 1819 under the title of 'Nouveaux Principes d'Economie Politique.' He had become intimate with Madame de Staël, and in 1805 accompanied her suite on a tour through Italy. The associations thus awakened appear to have called his attention particularly to history. The first fruits of his labors in this department appeared in 1807, in the first two volumes of his 'Républiques Italiennes,' which ultimately reached 16 volumes, and was not completed till 1818. It was followed by 'De la Literature du Midi de l'Europe' (1813, English translation by Roscoe, 1823). His 'Histoire des Français' (1821–44) occupied the greater part of his remaining life. It was carried to 31 volumes, though reaching no farther than 1750.

SISSOO, or **SISSUM**. See Dalbergia.

SISTER-SERVANTS OF SAINT MARTHA. See Orders, Religious.

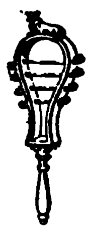
SISTERHOOD of the Good Shepherd; Sisterhood of the Holy Child; Sisterhood of the Holy Family; Sisterhood of the Holy Nativity. See Orders, Religious.

SISTERS, Apostoline; Sisters of the Assumption; Sisters of Atonement; Sisters of Bethany; Sisters of Bon Secours; Sisters of Charity; Sisters of the Divine Compassion; Sisters of the Faithful Virgin; Sisters of the Holy Child Jesus; Sisters of the Holy Cross; Sisters of the Holy Ghost; Sisters of Sagasse; Sisters of Mercy; Sisters of Misericorde; Sisters of Our Lady of Good Counsel; Sisters of Our Lady of Perpetual Help; Sisters of the Poor; Sisters of Providence; Sisters of Saint Agnes; Sisters of Saint Ann; Sisters of Saint Augustine; Sisters of Saint Benedict; Sisters of Saint Bridget; Sisters of Saint Dominic; Sisters of Saint Francis; Sisters of Saint John the Baptist; Sisters of Saint John the Evangelist; Sisters of Saint Joseph; Sisters of Saint Margaret; Sisters of Saint Mary; Sisters of Saint Monica; Sisters of the Sorrowful Mother; Sisters of the Transfiguration. See Orders, Religious.

SISTINE CHAPEL. See Vatican, The.

SISTINE MADONNA. See Madonna in Art.

SISTRUM, a primitive rattle or jingling instrument much used by the ancient Egyptians in their religious ceremonies, especially in the worship of Isis. It consisted of a thin somewhat lyre-shaped metal frame through which passed loosely a number of metal rods, to which rings were sometimes attached.



SISYPHUS, sĭs'ĭ-fŭs, a character in Greek mythology, son of Æolus, and husband of Merope, often quoted as an example of fruitless and recurrent toil. He is related to have been a king of Corinth and to have originated the Isthmian games. He tried to cheat death and gave offense to both Jupiter and Pluto. As a consequence he was condemned after being returned to the underworld to roll a heavy stone to the top of a hill, on reaching which it would always roll back again; thus making his punishment eternal.

SITA, in Hindu mythology, one of the incarnations of Lakshmi, goddess of prosperity, learning and love, and the beautiful wife of Vishnu. Certain holy devotees, having nothing else, gave their own blood as tribute to the tyrant Lanka; and from this blood Sita came forth, the most perfect and handsome of women. Another myth makes her the daughter of Janaka, king of Mithila. She is also called Parthivi (earth) and is said not to have been born of women but to have come forth from the furrow where her father was ploughing the earth. Hence the meaning of the word Sita is generally given as «furrow.» She seems to have been a nature goddess of productiveness or fertility. See Sri; Vishnu.

SITATUNGA. See Bushbuck.

SITKA, a tribe of the Koluschan stock of North American Indians, formerly residing on Norton Sound, Alaska, who were driven therefrom by the Russians to Baranof Island, where their principal village, Sitka, was established. In 1880–81 they numbered 720, of whom 540 resided at Sitka; in 1890 their population was 815. In addition to Sitka they had temporary villages at Hot Springs and Indian River.

SITKA (formerly New Archangel), Alaska city, port of entry, capital of the Territory, on the west coast of Baranof Island, 57° 30′ N. lat., about 1,500 miles north of San Francisco. It was founded in 1799–1800 by Alexander Baranov, the then Russian manager of Russian America. For a time Sitka grew in importance as a trading station and even as a manufacturing town. It was the commercial port not only of Russian America, but of the Pacific coast of America. The managers of the industries which made Sitka of importance failed in some of their enterprises, and gradually the place dwindled to an Indian village of about 100 log huts. Such the United States forces found it when they took possession 18 Oct. 1867. It is a coaling station for the United States navy and has a number of industries which not only supply the local needs, but which are a means of trade with the neighboring islands. In 1903 there were Russian Orthodox, Presbyterian, Roman Catholic and Protestant Episcopal churches. There were two public graded schools and the Sitka Training School (Presbyterian), an industrial school. In the training and industrial schools, special attention is given to farming and domestic science. Pupils from Sitka attend the Indian School at Carlisle, Pa. Among the places of interest are Saint Michael's Church, built in 1816 by the Russian Orthodox, the hospital and a museum. The rainfall is heavy, 85 inches annually, but the temperature is mild for the locality, the mean for December being 32°. The island has a great variety of trees, mosses and flowers; over 300 different kinds of wild flowers have been found here. Pop. about 1,200. See Alaska.

SITTING BULL, Sioux Indian chief: b. Dakota, about 1837; d. 15 Dec. 1890. He was the son of Jumping Bull and the nephew of Four Horns and Hunting-His-Lodge, all Sioux chiefs. He was first named The Sacred Stand, but at 14, having slain and scalped his first enemy, his name was changed to Sitting Bull (in Indian, *Tatanka Yotanka*). As a young man he showed enmity toward the whites and was repudiated by the more peaceable members of the tribe. During the Civil War he led in massacres of whites in Iowa and Minnesota, and in 1864 was driven by United States troops into the Big Horn country and to the Yellowstone. In 1866 he made a pretense of treating with the government, but the next year was again on the war path, and until 1876 was almost continually engaged in warfare with whites or friendly Indians. That year his band exterminated the force commanded by General Custer, sent against them on the Little Big Horn. After the massacre he escaped with his followers into Canada, and there remained until 1879, when to end a precarious existence he accepted the amnesty promised by Gen. N. A. Miles and returned to United States territory. Though submissive he was never friendly toward the government, and in 1888 influenced the Indians not to sell their lands. During the Messiah craze of 1890 his influence was considered dangerous and his arrest was ordered. In the attempt to carry out this order he was killed together with his son, several chiefs and members of the Indian police. See Siouan.

SIUT, sē-oot′, or **ASYÛT**, ä-sē-oot′ (ancient, Lycopolis), Upper Egypt. (1) The capital of a province of the same name, situated in a fertile district near the left bank of the Nile, 248 miles by rail south of Cairo. The town is about three-quarters of a mile west of the river, where a modern barrage and lock in connection with the great Nile irrigation scheme (see Assouan) was completed in 1902. The main street, running east and west, is about three miles in length. Among the chief buildings are the railway station, the government buildings, a good hospital, public baths, an American Presbyterian mission station, with schools, mosques, bazaars, etc. Plotinus, the great Neo-Platonic philosopher, was born here in 205 A.D. See Assiut. (2) The province, has an area of 768 square miles; pop. about 969,000, giving about 1,262 to the square mile; over 30,000 of the population are nomads.

SIVA, sē′vạ, the third deity in the great triad of Hindu gods. His name signifies in Sanskrit «happy,» «of good omen,» and he typifies both destruction and reproduction, but is generally regarded as the deity in the character of destroyer. His worshippers are called Saivas, and they assign to him the first place in the Trimûrti or triad, attributing to him also many attributes which properly belong to the other deities. According to the Saivas, Siva is Time, Justice, Water, the Sun, the Destroyer and the Creator. He is represented in his characters of the god of regeneration and of justice as riding on a white bull. He has five heads; three eyes — one on his forehead, indicative of his power of contemplation; two, four, eight or 10 hands; and in the middle of his forehead a crescent. His throat is dark blue; his hair of a light reddish color, thickly matted together and brought over his head so as to project like a horn from his forehead. He wears a garland of human skulls around his neck, and as a second necklace, a serpent; and in his hand holds a trident, surmounted by a skull, and one or two human heads. He is often represented as entirely covered with serpents, which are the emblems of immortality. His weapons are the *Khinkhira*, of which nothing is known, a bow called *Ajakava*, a thunderbolt and an axe. He resides on the wonderful Mount Kailâsa, the northern peak of the Himalaya. One of his principal attendants is Tandu, a teacher of the arts of dancing and mimicry, whence Siva is the patron of dancers. Siva has more than 1,000 names, which are detailed at length in the 69th chapter of the Siva-Purana. These names are mostly all derived from his attributes and character. Among the exploits of Siva is recorded his having cut off, in a fit of anger, one of the five heads of Brahma. He likewise beheaded his father-in-law, Daksha, for having offended his wife; but on the interference of the gods he placed a ram's head on the headless trunk.

SIVA-SNAKE, the king cobra. See Hamadryad.

SIVAS, sē-väs, or **RHUM**, Asia Minor, (1) Capital of the vilayet of that name on the Kizil

Irmak, 170 miles southwest of Trebizond, on the site of the ancient Sebastia. It contains some fine ruins of Seljuk art, chief of which are the *medresses*, or colleges of the 13th century. One of them contains the tomb of Izz-ed-din Kai Kaús I, the founder (1210–19). In the Armenian convent are preserved several relics, among them the throne of Senekherim. The heights (4,420 feet) are crowned by castles, and the general view, including mosques, minarets, colonnades, etc., baths, khans and bazaars, through which wind the narrow streets, is typically Oriental. There are Armenian churches, American and Jesuit schools and missions, and manufactories. On the route from Bagdad to Diarbeker and Malatiyeh and thence to the Black Sea, it is important commercially. The chief manufactures are coarse cotton cloth and woolen hose. The inhabitants are Moslems, Armenians and Greeks. Under Diocletian it became an Armenian capital, and was an emporium of wealth under Turkish dominion. In 1172 it was captured by the Seljuk sultan of Rhum. In 1400 when the city was taken by Timur it was a metropolis of 100,000 people; but never recovered from the atrocities perpetrated at that time. In 1895 a cruel massacre of Armenian Christians again decimated its population. Pop. 45,000. (2) Sivas is a large vilayet, and one of the most important of the country. Its area is 32,300 square miles. It has a productive soil; the main crops are wheat and barley; fruit orchards and vineyards are extensively cultivated. The forests are extensive, mainly fir, pine, oak and beech. The chief mineral deposits are silver, lead, salt, coal, iron, alum, arsenic and manganese. The exports include grain, flour, textiles, tobacco, opium, wool, carpets and cattle. The principal imports are cotton manufactures. The climate is salubrious. Pop. 1,090,000.

SIVASH, sē-väsh′, or **PUTRID SEA,** Russia, a salt lagoon on the northeast coast of the Crimea. It is separated from the Sea of Azov by a narrow sand bar, is 68 miles long and has an area of over 900 square miles. It is very shallow, and its water is stagnant and very salt.

SIVATHERIUM, a great ungulate mammal, almost as big as an elephant, whose remains occur in good condition in the Pliocene (Siwalik) deposits of India. After much discussion its place has been decided to be with the giraffes, although it has many similarities to such aberrant «antelopes» as the pronghorn and the saiga. The male had two pairs of horns, supported on bony cores, as in living antelopes, sheep, etc. The front pair of horns (on the frontal bones) were of simple form, while the larger hinder pair (on the parietals) were large, palmated and much like those of a modern moose, but less expansive. Murie has suggested that the sivatherium, like the existing prongbuck, may have shed the sheaths of its horns annually; and this theory may account for the fact that the horn-sheaths have never yet been found in a fossil condition. *Vishnutherium* and *Hydraspotherium* are closely allied genera.

SIWAH, sē′wä, or **SIVA,** Egypt, a small oasis 350 miles west-southwest of Cairo. It lies below sea-level and consists of a valley dotted by several lakes, prairies, palm groves, gardens and fields, abundantly watered and enclosed by steep hills. It is the easternmost of a small chain of oases, very fertile, has an abundance of dates, melons, olives, pomegranates, grapes, beans, barley, wheat and rice, besides salt. Basket-weaving and agriculture are the chief industries. Artesian wells abound. Agermih is the chief town, built upon steep rocks, and contains some ruins of temples and deep wells. An Egyptian gate and a large room covered with hieroglyphics are supposed to belong to an ancient royal palace. Here was the famous temple of Ammon, at least 2,300 years old. In the vicinity is the Fountain of the Sun, a salty spring. Pop. 3,750. Consult Hohler, T. B., 'Report on the Oasis of Siva' (Cairo 1900).

SIX NATIONS OF THE IROQUOIS, The. The five Iroquois tribes — the Mohawk the Seneca, the Onondaga, the Oneida and the Cayuga — speak dialects of the Iroquoian stock of languages. This stock is merely one of nearly 50 such linguistic groups on the American continent north of Mexico. This linguistic classification of languages into stocks does not by any means imply necessarily a community of blood descent among the peoples using the several dialects within each several stock, so that homogeneity of blood descent may not be consequently predicated of two peoples speaking dialects of the same stock. In the closing decades of the 16th century these five nations or tribes, or at least the main bodies of them, united in a defensive and offensive league or confederation under a constitutional form of government. It was a limited democracy, in which mother-rule was dominant.

The available historical data, although very meagre, make it probable that this act of federation was the last of a series of attempts to unite these and also other tribes in a permanent federal union. It may also be gathered from these same sources that the year 1570 A.D. is the approximate date of the founding of this remarkable league or confederation of the five Iroquois tribes or nations; the number was increased to six in the 18th century. At that time and for 200 years after they inhabited the central, the northern and the northeastern regions of what is to-day New York State.

Early French explorers and writers first called them the Iroquois; but when the exact geographic positions of these tribes became better known they named the Mohawk the Lower, and the four other tribes the Upper, Iroquois; but English authors, quite generally, knew them as the Five Nations. But, in 1722, the Tuscarora, a southern tribe, speaking a dialect of the Iroquoian stock of languages, became officially the sixth tribe of the federation or league of the Iroquois. Thenceforth, these six tribes (?nations) were usually called the Six Nations of New York Indians, often abbreviated to the Six Nations.

In 1535 A.D., Capt. Jacques Cartier, while exploring the Saint Lawrence River, obtained, from their Huron enemies, meagre but trustworthy information concerning the five Iroquois tribes, under the name «Troudamani» and «Agouionda.» He learned that a state of cruel, desultory warfare existed not only among the five tribes themselves but also between them on the one hand and the Huronian and other allied tribes, then dwelling on the Saint Lawrence, on the other. When Champlain, in exploring the Saint Lawrence River in the first decades of the 17th century, came in contact with the war-parties of the five tribes of the Iroquois, about 75 years after Cartier's time, he learned that they had so effectively harassed the Huron tribes who had formerly dwelt on the Saint Lawrence River as to compel them to withdraw to allied peoples then living on the banks of Lake Simcoe or to seek a precarious asylum among neutral tribes elsewhere. But, these Saint Lawrence regions, he found, were infested with marauding bands of the disrupted and dispossessed Huron peoples and of the tribes of Algonquian speech allied with them. These still stoutly disputed the Iroquois conquest of these territories. The dispossessed Huron tribes were sedentary, only leaving their villages and fields to hunt and to fish at certain seasons of the year. In 1622 Champlain attended a peace conference, at which were present Huron, Algonquian and Iroquois diplomats; it had been convoked for the purpose of bringing to an end a war which had then been waged, it was declared, for «more than fifty years.» Peace was finally concluded in 1624. But in 1626 these Iroquois tribes were at war with the Mohegan who had a palisade «opposite Fort Orange (Albany, N. Y.), on Castle Island.» Although inadvertently aided by the Dutch the Mohegan were defeated, and the Dutch commander and his men killed. It is said that some of the dead, including one or more of the Dutchmen, were eaten by the Iroquois. The peace concluded in 1624 with the Canadian tribes lasted for only about 10 years, for in 1634 these Iroquois tribes, or five nations of Iroquois, inaugurated a far-reaching policy which enabled them in subsequent years to overrun all Lower Canada and to take the first steps toward the entire subjugation of Upper Canada. The Algonquian tribes inhabiting the banks of the Ottawa River were either thrust back inland or entirely dispersed. In 1636 the five tribes or nations of Iroquois began a systematic raiding of the four federated Wendat or Huron tribes who lived around the shores of Lake Simcoe. And the complete political destruction of this Huron federation was accomplished during the summer of 1649. Then there followed the defeat and dispersal of the Tionontate or Tobacco Nation (Tribe). And in 1651 these Iroquois tribes attacked and utterly defeated the powerful Neuter Nation, the so-called Attiwendaronk, occupying what is to-day the southern peninsula of Ontario, Canada, and what is to-day western New York State as far as the Genesee River watershed.

These conquests made the five nations or tribes of the Iroquois complete masters of Upper Canada. And as a logical result they extended their sway over the conquered lands, held by the two tribes last mentioned, in what is to-day the State of Michigan. Then, in 1654–55, the war with the Erie took place; it ended with the complete political destruction of this intrepid people, for many of them became captives and were adopted as citizens of the commonwealth of their conquerors, while others fled to other tribes for asylum. These victories left the hostile tribes in the Susquehanna River Valley the only formidable enemies of the five nations or tribes at this time. Then, in this region, there was a respite from warfare of about 20 years. In 1676 the Iroquois of the five nations vigorously attacked the Susquehanna tribes, especially the Conestoga («Place Of Muddy Water»), who although supported by the Maryland authorities were nevertheless completely defeated and the valley of the Susquehanna became a highway for troops of Iroquois warriors going to attack the Virginia and Carolina tribes,— the Tutelo, the Sapona, the Achonechy (preferably Occaneechi), the Catawba, the Cherokee and other southern tribes with whom they had already been at war; the Conoy and the Shawnee were also subdued and brought under the dominion of the five nations of the Iroquois league or confederation.

Subsequent to 1680 the five nations of the Iroquois league attacked and defeated the Illinois tribes, driving some across the Mississippi River. In 1722 the Tuscarora became a sixth tribe or nation of the league or confederation of the Iroquois. Thenceforth these six tribes or nations were usually called the six nations of New York Indians, shortened sometimes to the six nations.

To commend and to secure their rule in the valleys of the Susquehanna and the Ohio rivers these six nations established a vast colonial policy, in pursuance of which they placed a vice-gerent on the Susquehanna and another on the Ohio to oversee and to advise the subject tribes in purely local affairs and to uphold federal law and to maintain federal rights and to secure justice by the reference of matters affecting these to the federal council at Onondaga.

The vice-gerent on the Susquehanna River was called Swatane by the Iroquois and Shikellamy by the Delawares. Both names signify «He enlightens us.» The vice-gerent on the Ohio River was named Scarouady by the Iroquois and Monacatuatha by the Delawares. The Iroquois name signifies «Beyond the Sky.» The meaning of the Delaware name is not definitely known. He was more frequently, however, mentioned as the Half-king. He lived first at Logstown, but in order to avoid the French influence he withdrew to Aughwick, Pa. It appears from the records that there were probably two in succession who held this office in the Ohio region. The first notice of such an official occurs in 1728, but of course this was not the historical date of the beginning of this unique native American policy. The so-called French and Indian War in the fifth decade of the 18th century brought this policy to an end. With the defeat of the Mohegan tribes on their eastern border in desultory warfare (1626–40) the Iroquois were finally able, about 1720, to bring the Delawares under subjection. They adopted them into the status of women, which by virtue of the very dominant civil and political position of Iroquoian women in their own social organization was not at all the act of humiliation that most writers on this matter have hitherto maintained. The position of woman among the Iroquoian peoples was rather one of power and respect, being in some measure superior to that of the warriors and the chiefs.

Champlain was drawn, largely by force of circumstances and ignorance of the spirit of the Iroquois tribes, into committing two costly blunders which together finally deprived France of her Canadian colonies. The first was his joining a Huron-Algonquian war-party, in 1609, while on its way to raid the territory of the five nations of Iroquois. On the shores of the lake which to-day bears his name he met an Iroquois war-party, which he and his allies defeated largely by the strange firearms of the Frenchmen, by which three of the Iroquois chiefs were killed; the second and more serious mistake was made in 1615, when he led an invading force of French and Indians into the lands of the five Iroquois nations; he advanced into these lands to the region about the present site of Syracuse, N. Y. There he attacked a palisaded fortification for four days, but after being severely wounded in the knee by an arrow he and his baffled allies — Hurons and Algonquian warriors — were compelled to raise the siege. This unprovoked overt act — the invasion of Iroquois territory by these Frenchmen and Indians — aroused the undying hostility of these five nations of the Iroquois League against the French. They afterward consistently opposed the French at every step until the close of the French régime in Canada in 1764. Thus, these five, later six, nations became the firm friends of the English who were at that time often at war with the French. But this English alliance finally became the cause of the disruption of the unity of the league as pointed out elsewhere in these pages. The pretentious raids into the Iroquois country by Champlain, De la Barr, Courcelles, Tracy, Frontenac, Denonville and others never greatly embarrassed the activities of these five nations, so that they were never, or at least only temporarily, prevented from gradually extending their sway south, west and north among the native peoples, their neighbors.

Owing to the fact that the policies of this League of five nations or tribes were formulated, amended and executed by five tribal committees of astute chieftains in the federal council, the league with measurable success was able to weather all these wars and changes. But the war of the American Revolution ruptured the unity of this great institution. Some of the tribes, true to their long-standing alliance with her, espoused the cause of Great Britain, while a small minority, composed chiefly of the Oneida and about one-half of the Tuscarora with a few from other tribes, remained faithful to the American colonies. This peculiar situation resulted from a decision of the federal council of the league to remain neutral in the impending conflict, as a federation, but nevertheless to permit each tribe to choose for itself its own policy in the premises. So that as a result of the defeat of the English people parts of the league may still be found in New York State and in Canada.

The social organizations of the six nations of the Iroquois and their congeners were strikingly alike, although, naturally, there were noteworthy differences in details. On the whole many features of their social organization were not very different from those of like purpose among tribes having a similar social development. But the social organization of the six nations of the Iroquois and their kindred tribes of the Iroquoian linguistic family differed from those of most tribes of other linguistic stocks in being measurably more complex, more expansive and more cohesive in its parts. A noteworthy difference between it and that of most other tribes is the dominant position and high public responsibility of the women who are mothers. This feature is a remarkable recognition of the nobility and the sacredness of motherhood. The chiefship titles, the lands and their products, and the lodges with their belongings are owned solely by the mothers of these people and these rights and prerogatives are ably administered by these very mothers.

Every candidate for a chiefship is named at a conference of the mothers of the *ohwachira* (uterine family) owning the title, under the premiership of the Matron of the *ohwachira*. The selection is then submitted for review and advice to the tribal and to the federal councils respectively. If the nomination is found satisfactory it is confirmed, but if it be rejected, the mothers aforesaid must again meet in conference in order to make another nomination. If necessary, this course must be repeated until a satisfactory candidate is found. The review is usually perfunctory; of course, the nomination is sometimes rejected, although the mothers naturally will present only such a candidate as they feel will be a credit to their *ohwachira*. After the institution of the league or federation the candidate had to be installed into office by federal officers at a federal condoling and installing assembly. This is a limited democracy in which the suffrage for the nomination of chieftains is confined to the mothers of the community.

In the original structure of the league or federation of the five (later six) nations no military officers were recognized. By amendment to the original instrument two of the federal chiefs (the one Onondaga and the other Seneca) were also made military officers. But it must be understood that these two officials could perform their military functions only outside of the sessions of the federal council. No federal chief could go on the warpath before resigning his federal chiefship, which he might resume on his return, if he was fortunate enough. There were three distinct classes of civil council chiefs among these tribes; they were the clan civil federal chieftains who while members of their local tribal council were at the same time also members constituent of the great federal council of the league or federation; and the two classes of clan civil chieftains,— the hereditary (the office but not the person) and the merit (or so-called "pine-tree" chief), who were the members constituent of their own tribal council only. But it must be noted that there was no such officer as tribal chief or chief of the tribe as an aggregation of clans known to the league, because the chieftain primarily represented only the *ohwachira* (uterine family) owning his title, the *ohwachira* being a constituent unit of the clan; the clan is, therefore, represented in council only by the chiefs of such of its *ohwachira* as may have chieftaincies. But sometimes there may be a clan in which no *ohwachira* may own a chiefship title and so it may not have representation in council.

The league or confederation as an institution or a form of government was an adaptation of that of the separate tribes even as that of the constituent tribes was an evolution of that of the several clans which composed each. Lastly, the government of the clan was an adaptation and expansion of that of the several *ohwachiras* (uterine families) composing it, and the *ohwachira* or uterine family, strictly speaking, was composed of the progeny of an ancestral mother and her female descendants, reckoning the line solely through the female blood. Persons of alien blood could be adopted only into such a kinship group. So the clan may be defined as a permanent body of blood kin, socially and politically organized, who derive actual or fictional descent through the female line only, from a common ancestral mother. It is a fact that the less complex units of kindred surrendered part of their autonomy to the next higher units of organization in such manner that the whole was closely cohesive and interdependent. The institution of a higher kinship unit created new privileges, duties, rights and obligations. This was the principle of organization of the confederation of the said five (later six) Iroquois tribes or nations.

In nautical matters the five (later six) nations of Iroquois were measurably inferior to the Huron and the Algonquian tribes of Canada. The canoes of the former were constructed of elm bark and were of clumsier workmanship and they were no match for the beautiful birch bark canoes of the latter. So it is found that in most of the canoe fights mentioned in history these Iroquois tribes were usually worsted. After the establishment of the league or confederation the five federated tribes of Iroquois lost no time in making their united power felt. The evidence of this fact is found in the expulsion of the two Wendat (later Huron) tribes from their habitat on the Saint Lawrance River, about the close of the 16th century. When the Dutch traders established themselves at Fort Orange near the present site of Albany, N. Y., these Iroquois tribes obtained firearms from them and were thereby enabled to extend their conquests over practically all the neighboring tribes, in such manner that their sway was acknowledged from the Tennessee to the Ottawa River and from the Kennebec to the Illinois River and Lake Michigan; the Chippewa, however, checked their westward advance; the Cherokee and the Catawba and their allies effectually barred their further advance southward, while at the north they were much hampered by the operations and machinations of the French and their native allies. A list of the tribes against whom they raised the hatchet is simply startling. In brief, they attacked more than 28 Algonquian tribes, 12 Iroquoian tribes and at least three Siouan peoples. So that by 1664, when the English displaced the Dutch at Albany, the conquests of the league of the Iroquois or five nations had extended so far that the sway of these tribes was supreme over the native tribes in practically the entire valley of the Saint Lawrence River. In 1666 the five nations of the Iroquois league made peace with the French and their native allies who had attacked and burned some of their villages. Both parties to this peace observed it for a long period. The league was organizing to push its conquests further south and west than they had previously done.

Their wars were waged primarily for the security of their homes and their hunting lands and for the perpetuation of their independence and political life, briefly, for the preservation of their institutions and for the welfare and integrity of their unique commonwealth.

The French in the latter part of the 17th century made a number of attempts through the Jesuit missionaries to induce the people of the five federated Iroquois tribes to break off their English alliance and to emigrate to Canada and to come under French jurisdiction. These attempts were so far successful that numbers from the different tribes, chiefly the Mohawk and Onondaga, left their former allegiances and formed Catholic settlements in Saint Regis, the Bay of Quinté, Oka, Lake of the Two Mountains and Caughnawaga, on the Saint Lawrence River. The tribes of the league, however, made repeated unsuccessful efforts to induce these emigrants to return to their former homes, and so in 1684, after realizing the futility of their efforts, they declared these emigrants traitors to the peoples of the league. The residue of the peoples of the five nations occupied their original habitats until the Sullivan raid in 1779 dislodged them and caused some to seek new homes elsewhere. Those who did not emigrate, live on reservations in New York State and those who did, live in Ontario, Canada.

The constructive principles of right and justice, underlying the institution of the league or confederation, defined primarily the rights and the obligations arising from blood kinship and affinity. Their internal and their foreign polity was molded and guided in consonance with these principles. The motive for the institution of the league was avowedly to secure universal peace and welfare (*Ne" Skĕñ'noʷ'*) among men by the recognition of the equality of rights and obligations among citizens of their commonwealth and the establishment of righteousness and justice (*Ne" Gāi'hwi'io*) in directing and regulating personal and public conduct by them; and by the stopping of bloodshed through the proscription of the bloodfeud by the tender to the aggrieved family of the prescribed price for the killing of a cotribesman or cotribeswoman; by abstention from the eating of human flesh; and, lastly, by the maintenance and the effective exercise of power (*Ne" Gă's'hasdoⁿ"să'*), not only military strength but also the magic power (the *orenda*) believed inherent in the forms and words of their ceremonial, social and political activities. The tender by the offender and his family (*ohwachira*) to the aggrieved family (*ohwachira*) for the homicide of one of its members was 20 strings of wampum — 10 for the dead person and 10 for the forfeited life of the offender; but, if the victim was a woman, 30 strings were required, as the value of a woman's life was held to be double that of a man.

The tribes in question were of course sedentary and agricultural, deriving only a portion of their subsistence from their hunting and fishing grounds. Skill and adaptability in lodgebuilding and in the construction of palisaded fortifications were marked characteristics of these tribes when first encountered. In political organization and statesmanship, in military prowess and in the aptitude to found their institutions on universal principles of right and justice and mercy these five (later six) nations were second to no other native Indian people north of Mexico. The astute diplomats of France and England who at different times treated with their wily leaders found them their peers and exemplars in statecraft. Each tribe was an independent political unit and exercised the rights of local self-government, but in all federal affairs it acted jointly with its confederates through a federal council, composed of chiefs who were members of both the tribal and the federal councils. Every tribal (i.e., clan) chief was not a federal officer.

Before the great principles of the league or confederation of the five (later six) nations were constructively formulated into a system of interdependent federal institutions the avowed polity of these five (later six) nations of the Iroquois was a narrow tribalism which naturally regarded and treated all other people as game or as animal pests to be destroyed for the common good. This harsh, although orthodox, standpoint was not altogether changed by the universal principles of reconciliation and goodfellowship adopted as the working forces of the institutions of the league or federation by its great founders. So in the warfare of the league or federation prisoners were subjected to the most ferocious cruelty; unadopted women and infant prisoners were at times burned as alleged reprisals for similar treatment by their enemies. Yet, withal, they were not «a race of rude and savage warriors» but they were «a kindly and affectionate people, full of keen sympathy for kin and friends in distress, kind and deferential to their women, exceedingly fond of their children,» anxiously striving for the establishment of peace and goodwill, righteousness and justice and mercy, among men, and profoundly imbued with a just reverence for the institutions of their federal commonwealth and for its noted founders and prophet statesmen and stateswomen.

The religion of these six nations or tribes of the Iroquois like that of all other peoples of this linguistic stock consisted in the recognition and the worship of unseen forces and beings whose expressions were embodied in all the environing objects and powers and phenomena and in many fictions of mythopoetic fancy, which, directly or remotely affecting their welfare or causing their illfare, were regarded as anthropic personages, in fact, as man-beings, endowed with human life, volition and peculiar orenda (or magic power, which is the only impersonal concept of their philosophy). Form is the logos or expression of creative spirit. This makes it clear that the people of these tribes were not at all idolators in the usual sense of this much-abused term. This religion, however, placed emphasis on the punctilious performance of the rituals and the strict observance of the customs and ceremonies upon which these rest, rather than on theories of morals or ethics as such. Nevertheless, many of their ethical standards express ideals not yet attained by modern culture and civilization. Some have been formulated into law. The orphan and the poor were not known as such in their polity. The food-supply — even the best of it — typified by a beaver's tail contained in a bark-bowl (the most delicious morsel known to them) — was made free to every person. The most desirable flesh was of the absolute right of every person who was a citizen of their commonwealth, their state.

In the pantheon of the Iroquois the status and the personal relations of the deities and personages thereof were naturally governed by regulations and customs, derived directly from those prevailing in the social and political organizations of the people, and so there is among the chief gods and goddesses of their faith a kinship system identical with the fabric of interrelated duties, obligations and immunities of the prototype — the kinship system of the people themselves. This is the psychology of the divine institutions of Iroquois faith.

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SIX-PRINCIPLE BAPTISTS. See Baptists.

SIX-THREE-AND-THREE PLAN. See Education, Elementary.

SIXTEENTH CENTURY. This century is one of the most important in modern history, first as the terminal phase of the Renaissance, and, second, as the beginning of the religious upheaval called the Reformation, or more recently «The Religious Revolt in Germany.» The still living spirit of the Renaissance made the century a period of great art. Leonardo da Vinci and Raphael died not far apart (1519–20). The great Venetian painters, the Bellinis, Titian, Tintoretto, Veronese flourished, and such men as Correggio and Botticelli, not to mention a whole host of lesser lights, lived from the preceding century and did some of their best painting which has always been an inspiration. Architecture decayed to some extent, but it was in this century that Michelangelo built the great dome of Saint Peter's at Rome, and some of the finest Italian palaces were planned and constructed. Sculpture under the group of men from Michelangelo and Benvenuto Cellini to John of Bologna, achieved masterpieces that were to be forever famous.

Italy was not alone in this great development of the arts, for such men as Jean Goujon and Germain Pilon were distinguished as sculptors in France, and the châteaux of the Loire are enduring monuments of French architecture and great beginnings of French paintings were made. German painting had Dürer and the Holbeins and sculpture the Visschers and Adam Kraft. In Spain, as well as in the Netherlands, there came a fine initiative for the supreme period of their painting which was to follow in the next century. Only England was not touched by the art spirit of the time, though the response in literature in the magnificent Elizabethan period must be credited to make up for it. While it is not generally realized, the Renaissance evoked a great literature as well as a great art in all the countries of Europe. The development of this was somewhat delayed, and occurs in the 16th much more than the 15th century. It included Ariosto and Tasso as well as Vasari, Machiavelli, Lorenzo de Medici and Benvenuto Cellini in Italy; Marguerite of Navarre and the Pleiades, Ronsard, Rabelais and Montaigne in France, Cervantes and Lope de Vega, with Saint Teresa and the great mystical writers in Spain; and Camöens in Portugal. The culmination of Renaissance literature came in the Elizabethan period in England. Michelangelo, poet as well as artist, died just two months before Shakespeare was born, and the two men are complements of each other at the extremes of cultural Europe. The Teutonic countries presented a great development of scholarship though not of original literature.

The art of the 16th century is, however, its greatest chapter. It contains all the work of Raphael, the greater part of that of Michelangelo, not a little of Leonardo da Vinci, most of Titian and all of Tintoretto and Veronese, not to mention a number of men who in any other period would be looked upon as of the very first rank. Raphael has been called the greatest painter of all time and while modern art criticism has discounted that flattery, scarcely any one would be ranked above him. When he died at the age of 37 he had reached distinction as an architect and archæologist as well as a painter. Narrow specialism was extremely rare in the Renaissance and many men did many things well. Titian is one of Raphael's great rivals; some of his Madonnas are among the most beautiful in the world. Delacroix declared that he came closest to the spirit of antiquity. Another great painter of the time whose work is growing in appreciation in our time is Correggio. Leigh Hunt declared him the most skilful artist since the ancient Greeks in the art of foreshortening. He was master of every technical device in painting and this was a time of fine technique. Tintoretto has been restored to modern estimation by Ruskin. Paolo Cagliare, known as Veronese, was a master of decoration and no decorative painter has equaled him in the effective use of color. It is easy to trace art decadence in the century but not difficult to understand it, once it is appreciated that at the beginning Botticelli was doing his famous *tondi* or *rondo*, Leonardo-da-Vinci was painting the 'Mona Lisa' and Fra Bartolomeo had just come under the influence of the Venetians and the spell of their rich color. It would have been almost impossible to expect that painting could be maintained on any such high level as all this indicates.

The century witnessed the career of the man often declared to have been the finest intellectual and artistic genius who ever lived, Michelangelo Buonarotti. He is the most distinguished of sculptors since the Greeks. Some of his painting rivals that of the very greatest painters. His decoration of the Sistine Chapel made him forever famous and has been the subject of reverend study ever since. As an architect he is undoubtedly one of the world's supreme geniuses in construction. Without steel or steam or any mechanical aid except a mule and an inclined plane, he built the great dome of Saint Peter's, one of the architectural wonders of the world. Meant to be seen as the first object visible in Rome to the travelers who, in the old days, came over the mountains in carriages or on horseback 20 miles away, it looks more like a work of the Creator than of the creature. This greatest of sculptors, painters, architects, has written sonnets that have only been equaled by Dante and Shakespeare and have never been surpassed. In every mode of æsthetic expression, he was a master in the highest sense of the word. After having worked hard all his life, he lived to be nearly 90 in the full possession of his faculties. His personal character is equal to his genius. He was a deeply religious man who all his life had been well known for his thoughtfulness for others. He left a sum of money in his will, the income of which was to be "given for the love of God to the modest poor." One of his sonnets is a prayer that he may not let himself become so occupied with the mere trifles of life as to forget that it is a preparation for another. Vittoria Colonna declared that those who admire Michelangelo's works admire but the smallest part of him. The artist is often a disappointment after his works; Michelangelo's personality had just the opposite effect. At the end he declared that "life, which had been given us without our asking, had wonderful possibilities of good in it, and death which came unsummoned from the same Providential hand could surely not prove less full of blessing."

The period is famous for its devotion to the arts and crafts. The furniture is noted for its charm of design and fine execution and was often designed by the great artists. Objects for church use were made the most beautiful works of art. A thurible or censor made by a pupil of Leonardo da Vinci sold at auction recently for some $60,000 because it was thought to be the most beautiful piece of bronze work of its kind in the world. Candelabra for church and home use, cups, plaques and other articles were made with similar perfection. Some of Benvenuto Cellini's work of this kind is very precious. Artistry was the keynote in every department of life. When Aldus published (1501) his Virgil in italics, the designer of the type was Francia, the famous painter at Bologna who had designed all Aldus' previous fonts of type. The home beautiful was the special cult of the time. The ladies of the Renaissance planned charming private apartments, music-rooms, art galleries and reception-rooms which reflected their personalities and are the most beautiful of their kind ever created. Some of them have been reproduced in modern museums in the hope of stimulating emulation. The apartments of Lucrezia Borgia at Ferrara were particularly famous. Landscape architects made the gardens surrounding these houses beautiful and artists were appealed to to plan details of all kinds so as to be sure that all would be beautiful as well as useful.

Painting outside of Italy flourished wonderfully and the names of Albrecht Dürer and the Holbeins in Germany, of the Clouets, Cousin and Fouquet in France and of Navarete, of Juan Bourgona, of Louis de Vargas and Pablo de Cespedes in Spain, as well as Mabuse, Van Orley, Blondeol and Justus of Ghent in the Netherlands all live in honor among those interested in the history of art. In sculpture there is a distinct descent from the preceding century, except for some great work of Leonardo da Vinci and Michelangelo, but the sculptures of John of Bologna and Benvenuto Cellini deeply influenced succeeding generations and are greatly admired in our time. In France, Goujon's reliefs for the Fountain of the Innocents are among the most beautiful works of their kind ever produced. Germain Pilon's group of the Three Graces is a monument to the refined tastes of the time, and to the genius of the sculptor, even though it may show signs of the beginning of decadence. In Germany the great group of figures for the monument of the Emperor Maximilian at Innsbruck, executed early in the 16th century, shows how high were the standards of plastic art everywhere at this time. Saint Sebald's tomb, executed by the Vischers, father and son, at Nuremburg remains one of the unapproached marvels of a great period. There were many foci of fine artistry in southern Germany during the period.

The Elizabethan Period in English literature is, with the art of Italy, the twin triumph of the century. It holds all of Marlowe's writing and up to the very flowering of Shakespeare's genius. It has, besides, the poetic beauties of Sidney and Spenser, the marvelous English of Chapman's translations and the best of Ben Jonson's dramatic work. It is not only the greatest period of literature in English, but one of the greatest periods of world literature. The English people were extending their domains beyond the sea. The peril from the Armada had deeply stirred the English mind and the reaction after the victory gave a great stimulus to thought and writing. As is so often the case when the country was growing in national importance, intellectual genius bloomed also and so "the spacious times of great Eliza" furnished a stimulus that was well responded to. A very great period of dramatic literature developed quite unexpectedly, continued for a generation and then began to decline. By the end of the second generation the inspiration had faded and only conventional work was being done.

This century saw a wonderful outburst of European literature, culminating in the latter part. The Elizabethan period in England was rivaled in other countries. In Portugal Camöens wrote ‘Os Lusiadas,’ the epic story of Portuguese exploration of Africa and Asia and of the foundation of Portugal's Indian empire. Friedrich Schlegel declared it the greatest epic of modern times. In Spain came the beginnings of the careers of Lope de Vega and Cervantes; in France Rabelais, at the beginning of the century, Montaigne, at the end, did their work; in Italy Ariosto and Tasso. Had Shakespeare visited the Continent as a young man he might have met nearly all of these. The writers of the most humanly interesting play, ‘Hamlet,’ of the greatest novel ever written, ‘Don Quixote,’ of the greatest modern epic, ‘Os Lusiadas,’ of the greatest letters (Saint Teresa) and the greatest essays (Montaigne) were all doing their work together in the last quarter of this century. Some of them were to accomplish their best work only at the beginning of the next century, but their inspiration came from this.

The cultural development of the Spanish-American countries during the century is one of the surprises of recent historical research. Schools were established in Mexico and Peru during the second quarter of the century and in 1551 the universities of Mexico and Lima received royal charters. During the last quarter of the century, medical and law departments were organized and these universities had many hundreds of students. The printing press was introduced into Mexico (1536) and the first book printed was ‘La Escale Espiritual’ (‘The Ladder of the Spirit’) the following year. Seven printers plied their craft in the century. Professor Bourne of Yale declared that Mexican scholars before the end of this century "made distinguished achievements in some branches of science, particularly medicine and surgery, but especially linguistics, history and anthropology." In the following century there were chairs in all the sciences and "some of the professors, notwithstanding the vast distance, gained the applause of the litterati of Europe. In range of studies, in standard of attainments by the officers, the Mexican institutions of learning surpassed anything that existed in English America until the 19th century." (Bourne). The university was granted by the Crown an income of about $10,000, so that considering the value of money, apart from fees and other sources of revenue, it had the equivalent of an income of $100,000 a year in our time.

The most fascinating character of the century whose work has lived on after him and has deeply influenced the after world is Ignatius of Loyola. A Spanish soldier, wounded at the siege of Pamplona by the French in 1521, he had his leg rebroken when it had healed in bad position, bearing the awful pain in those pre-anæsthetic days, rather than have his pride annoyed by the deformity. During the enforced idleness he read, after exhausting all the romances of chivalry at hand, a life of Christ and lives of various saints, particularly that of Saint Francis of Assisi, and came to the conclusion that life was only worth living when lived in imitation of the God-Man. Amidst many almost incredible difficulties, for more than a dozen years he formed his character by spiritual exercises, took up the study of grammar in a class with little boys, supported himself by begging as one of the beggar students of the time, and gathered around him at the University of Paris a group of seven men, who in 1534 took their vows with him as members of the Company of Jesus. With true Spanish chivalry, their first object was to win over the Holy Land from the infidels by going to Jerusalem and converting it. Prevented by war from doing this, they became teachers and missionaries in Italy. Their zeal was so great and yet so reasonable, they were so absolutely unselfish and had a charm that attracted so much attention, that they accomplished wonders. The Pope received them with kindness and gave them provisional confirmation of their rule. Pope Paul III had insisted on limiting the number of religious orders because of abuses that had arisen in them, but after reading Ignatius' rule he declared "the finger of God is here," gave them the fullest confirmation and in 1543 they were acknowledged as one of the religious orders of the Church.

The Jesuits, thus simply founded, proved to be one of the creations of that great period most far-reaching in influence. By the end of the century they had schools in nearly every country of Europe, with many thousands of pupils. A hundred years later they had some 200,000 pupils. They went as missionaries to China and Japan, Mexico, Peru, Brazil, Paraguay and Chile, to Farther India and to the North American Indians. They wrote many thousands of books and their bibliography contains over 11,000 authors. The list of Bellarmine's works fills 50 pages, double column, one of them published in 54 languages. They were discoverers in astronomy, founders in anthropology and ethnology, writers on every scientific topic, and Poggendorff has 500 of them in his 'Biographical Dictionary of Science.' The last prayer of Ignatius was that his order should be persecuted. As Francis Thompson said, "Most singular bequest that a founder ever transmitted, it has been singularly fulfilled." Suppressed by the Pope in 1773, they survived in Russia, were restored in the early 19th century and there are over 20,000 Jesuits in the world now.

The most disputed character of the century is Martin Luther. Lord Acton once declared his life the most difficult problem in historical writing. The movement initiated by him separated the Teutonic peoples from the Pope and then made their monarchs the head of both Church and State (*Cujus regio ejus religio*). There had been unfortunate abuses within the Church and many felt that these could not be corrected without breaking away from Rome. A number of deeply religious people followed Luther out of the Church for this reason. Political motives and the confiscation of the property of the Church and of the religious orders helped the movement. Sweden affords a typical example of this. Most of this property had been held in trust for the poor and for education. In the religious conflict which followed, social organization for the benefit of the poor and education suffered severely. Fewer universities were founded, the attendance was smaller, intellectual life declined (Erasmus), there was less academic freedom (Paulson). Luther's doctrine of liberty of judgment and personal interpretation of the Scriptures soon led to a multiplication of sects, each bitterly opposed to the others. Calvin in Switzerland and Knox in Scotland are as difficult to estimate properly as Luther. They too gathered round them many of those in their environment most deeply interested in religion. Rev. Dr. Briggs suggested that there were other and greater reformers in the century than these popular heroes. He mentioned Sir Thomas More, Erasmus and John Von Staupitz as "the three irenic spirits . . . the beacons of the greater reformation that was impending." Luther's movement began a reaction for sadly needed reform in the Church which was directed by the Council of Trent (1545–63). Henry VIII, after having received the title of Defender of The Faith for writing against Luther, broke with Rome over the affair of Ann Boleyn and became by act of Parliament the head of the Church as well as of the State. The Anglican Church as such did not come into existence until under the boy king, Edward VI (1547–53). Queen Mary (1553–58) restored Catholicism. Anglicanism was firmly established by Elizabeth (1558–1603).

The Protestant Reformation undoubtedly brought about a great reawakening of personal religion and aroused the clergy to an ampler sense of their duties in leadership with regard to their flocks. Religion had come to be for a great many people a convention, lacking those personal elements of relationship between man and his Creator which foster the spiritual life. The Renaissance served to set the intellect of Europe rather definitely against religion, though its great leaders were exceptions to this and a profound reawakening of the spiritual life of the people was needed. The movement is too close to us even yet to be properly appreciated in its entire significance though the World War has helped to its understanding.

The greatest accomplishment of the century was in exploration and colonization. The expedition of Bartholomew Diaz around the Cape of Good Hope to India (1487) and Columbus' discovery of America initiated a great period. The Cabots touched the American continent at the north and Vespucci at the south just before the century opened. Magellan's vessels sailed around the world, though he lost his life on the way. Verrazano, an Italian with a French expedition, sailed along the coast of North America and entered the harbor of New York (1524). By the mid-century many of the islands of the Pacific had been discovered, including Australia; the Portuguese laid the foundation of their great empire in India, and Pizarro and Cortes had founded the Peruvian and Mexican possessions of the Spanish Crown on the American continent. By the end of the century there was free European intercourse with the East and the West and the riches of both these wealthy portions of the world were pouring into Spain and Portugal, stimulating an intense national life which gave rise to a great literature in both countries. England was preying upon the commerce, particularly of Spain, enriching her people and preparing to take up colonization for herself at the beginning of the next century.

The century witnessed the foundation of modern music. The greatest genius of it is Palestrina. He is to music what Dante is to literature and art, and whenever he is properly appreciated that generation has a good musical taste. The beginnings of the century's music comes from Flanders. Archadelt, the master of Palestrina, wrote some church music which is still used. Claude Goudimel, another Fleming, influenced his time deeply and as the master of Orlando di Lasso, the first to co-ordinate words and music so as to harmonize and bring out the meaning of both, influenced all the aftertime. Other pupils of Goudimel were the brothers Animuccia who created the *Oratoria*, named in honor of the oratory of Saint Phillip Neri, their great friend, at Rome. Josquin (Josse Despres) in France and Hans Sachs in Germany laid the foundation of modern popular song music and foreshadowed many subsequent developments.

The foundations of the physical sciences were laid broad and deep in this period. The greatest scientific discovery is that of Copernicus, who revolutionized man's thinking as to the universe more than any other who ever lived. He did not make many observations nor were those he made particularly exact, but he reached a magnificent generalization, the Copernican theory, which has come to be the accepted teaching as to the universe. His theory was not acceptable to his generation and practically all the mathematicians and astronomers objected to it. It was not generally accepted until the generation after Galileo in the following century. Copernicus' studies had been made in Italy; it was there, according to tradition, that he first hinted of his theory, and when he published his book it was dedicated with permission to Pope Paul III. Until Galileo's unfortunate insistence on teaching the theory as absolute science, there was no hint of opposition. Copernicus' greatest scientific contemporary was Leonardo da Vinci, whose work in science belongs to this century (died 1519). Leonardo discovered capillarity and diffraction, made observations on resistance, on density, on the weight of air, on dust figures, on vibrating surfaces and on friction and its effects. Duval has claimed a place for him in the history of the biological sciences for his original observations in botany, zoology, paleontology and physiology. He developed practical engineering, studied the problems of flying and made a series of very practical inventions. He was a zealous dissector and made sketches of his work which, rediscovered in recent years, show clearly that his proposal to write a textbook of human anatomy was quite serious.

The biological sciences developed strikingly, beginning with Vesaliusoe, the "father of modern anatomy," who wrote a great textbook, magnificently illustrated, and still one of the bibliophilic treasures of medicine. His pupil, Columbus, working as a papal physician at Rome, discovered the circulation of the blood in the lungs, and one of his successors in the Papal University, Cæsalpino, described the circulation of the blood in the body. In the meantime, Servetus, a Spaniard working in Paris, had written a description of the circulation in a theological work on the Trinity, for which, unfortunately, he was put to death by Calvin at Geneva.

Many other important discoveries were made in Italy at this time. The names of Eustachius, Fallopius, Varolius, Sylvius, are forever enshrined in the history of medicine because of structures named after them which they were the first to describe. After anatomy, botany developed the most and Cæsalpinus, the anatomist, is called by Linnæus "the first systematic botanist." Many of the universities had botanical gardens of their own and collections of plants for study were made. The great names in botany are Valerius Cordus, Conrad Gesner and Leonard Fuchsius. Before the end of the century, the calendar was corrected under Pope Gregory XIII to the form we now have and some extremely important developments in practical medicine and surgery had been made. Italy was the great Mecca for enthusiastic students of science and Copernicus, Linacre, Vesalius and Caius in the early part of the century as Harvey later went down there to do special work. Padua was the most famous university of the world and almost no ambitious young university man in another country felt that he could count himself fortunate unless he had been there.

One of the supremely great men of history was Sir Thomas More (beheaded 1535). A close personal friend of King Henry VIII, he was sent on an embassy into the Netherlands (1516), and while there wrote 'Utopia,' probably the most interestingly practical of the books on ideal republics ever written. He had been, before this, one of the group of men, including Erasmus, Linacre and Dean Colet, most prominent in the Renaissance in England. Erasmus thought him one of the greatest minds of the time. On the fall of Wolsey, Henry VIII insisted on making More, Lord Chancellor. Wolsey declared him the most suitable to be his successor, but the post was accepted not without misgivings on the part of More. His well-known sympathy for the poor and his sterling uprightness of character had made him popular, so that his installation took place "to the joy and applause of the whole kingdom." His career fulfilled expectations. He is the only man who ever cleared the docket of the Court of Chancery. More refused to take the Oath of Supremacy, that is, that the king was the head of the Church. Practically all the bishops of England except John Fisher had consented to take the oath by some evasion of conscience, but More persisted in refusing. He was executed for treason going to the scaffold with a joke on his lips. Lord Campbell ('Lives of the Lord Chancellors') says, "Considering the splendor of his talent, the greatness of his acquirements and the innocence of his life, we must regard his murder as the blackest crime that has ever been perpetrated in England under the form of the law." He adds, "The mean, sordid, unprincipled chancellors who succeeded him made the latter half of the reign of Henry VIII the most disgraceful period in our annals."

The century embraced the careers of a number of women in whom interest has never died. The list includes Vittoria Colonna and Marguerite of Navarre who corresponded with each other, Isabella and Beatrice d'Este, Saint Teresa, Lady Jane Grey, Mary Queen of Scots, Queen Elizabeth, Margaret More, Charitas Pirkheimer and Angela Merici, not to mention any but those whose lives are still felt. Queen Isabella of Spain lived on into the century but her work was done mainly and has been treated of in the 15th century. Vittoria Colonna, called the Saint of the Renaissance, was a wonderful character of fine intelligence and broad education who deeply influenced her own and subsequent generations. She wrote some religious poetry that is still republished, but it was her personality that counted. Her deep impression on Michelangelo in his old age, as demonstrated by his sonnets to her, some of the greatest ever written to a women, reveal her power. The contrast to her would seem to be Lucrezia Borgia, whose name has become the byword for all that is worst in feminine human nature, but Gregorovius has vindicated her. Her contemporaries deeply loved and respected her. Aldus, the great printer, who knew her well, praises her charity to the poor, her unselfish devotion to the afflicted and her ability as a ruler. Chevalier Bayard, *sans peur et sans reproche,* declared «that neither in her time nor for any years before has there been such a glorious princess.» When she died at the early age of 40, all of Ferrara, where the last 20 years of her life were spent, followed her body to the tomb as that of a saint. Her popular reputation is a lesson of the fallibility of historical traditions without contemporary documents.

Saint Teresa of Spain has been called the greatest of intellectual women. Her works are still issued, edition after edition, in many languages. A number of 'Lives' of her have been written, even in English in this present century. Cardinal Manning, himself the most practical of men, declared that «she was one of those sovereign souls that are born from time to time, as if to show what her race was created for at first and to what it is still destined.» The Spaniards call her their Doctor of the Church, and her statue, the only one of a woman, is among the Fathers and Doctors of the Church in Rome, with the title *Mater Spiritualium.* She is the world authority on mystical theology and an unsurpassed writer of Spanish prose. It has often been said that from behind her convent grill she, more than any other, was the barrier against that divisive religious movement which caused such bitter dissensions in most other countries of Europe, but spared Spain. In striking contrast to her is Marguerite of Navarre, sister of Francis I of France, herself a queen, whose volume of stories, the 'Heptameron,' is still popular in every language, while her poems, 'Les Marguerites de la Reine Marguerite' are known to all lovers of literature. She had an extremely beautiful character and radiated the finest influence over her generation. In order to neutralize the evil done by certain immoral stories current at court in her time, she retold them in literary form, adding morals to them. Like so many good people, she had the idea that human passions may be influenced for the better by sweet reasonableness. Instead of doing good, her book has done harm. Most people read the stories and not the morals, or when they read both, forget the morals promptly, while the evil suggestions remain.

Mary Queen of Scots is one of the much-disputed characters in history. After 18 years in prison, she was beheaded, at the age of 44. She was crowned queen of Scotland as an infant on the death of her father, James V (1542). At the age of 16 she was married to the Dauphin of France. Her husband became king as Francis II of France when she was 17. He died the next year and at 19 Mary returned to try to rule the turbulent Scottish barons. At 25 she was imprisoned and was released for two weeks only, when she threw herself on Elizabeth's mercy, who kept her in prison until her execution. She lived in the most difficult of times, and this brilliant intellectual woman, whose heart sometimes led her astray, is a type of the Renaissance. Her successful rival for the throne of England, for on Queen Mary's death Mary of Scots had claimed the English throne as well as Elizabeth, is a greater genius without heart. She had the discernment to gather around her the men who laid broad and deep the foundations of modern England, and its colonial empire. The «Good Queen Bess» of traditional history has suffered severely from modern historical research. She was a woman of great administrative ability, but of lamentable personal character. Prescott say of her, «she was haughty, arrogant, coarse and irascible, while with these fiercer qualities, she mingled deep dissimulation and strange irresolution. . . . She was desperately selfish, incapable of forgiving, not merely a real injury, but the slightest affront to her vanity, and she was merciless in exacting retribution.» She had her father's Tudor character, but his genius for managing men.

The founder of feminine education in the century was Angela of Merici. A young woman of the lower middle class, of a small town of Italy, she recognized that not only the better class women but all women needed to be educated in order to bring up their children properly and influence those around them for the best. She established a little community for the teaching of girls. Under her direction this movement spread and she wrote a rule for the women who had come to share her work. In approving this constitution, Pope Paul III said to Saint Ignatius, the founder of the Jesuits, «I have given you sisters.» The Ursuline schools spread over Italy in a single generation and they had houses in Paris and Bordeaux in the second half of the century. They opened a school in Canada in 1639 and one in New Orleans in 1726. They were the first to offer more than a common-school education for girls, in the northern United States at least, though their house at Charlestown, Mass., was burned down by a mob in 1834. Most of the pupils at the convent at the time were from some of the old Puritan families of New England. The Ursulines have taken up college work for women in our time very successfully and they have schools all over the world with many thousands of members at work.

The most important historical event of the 16th century is the battle of Lepanto (1571), which marked the definite defeat of the Turks and put a period to the long fight between Christians and Mohammedans which had been in progress for nearly a thousand years. Pushed out of Spain and halted in the Balkan region, the Mohammedans had gradually acquired dominion in the Mediterranean Sea, had taken Cyprus and almost succeeded in capturing Malta from the Knight Hospitallers who defended it with a dauntless courage which finally gave them the victory. Something had to be done to stay their progress. Thousands of Christians were being captured every year by Turkish pirates and held as slaves in the cities of the Barbary Coast or even being sold into the East. The Turks were making incursions on coast cities with great destruction and loss of life. Under the inspiration of Pope Pius V, an alliance was formed between the Venetians and Phillip II of Spain, whose commerce had suffered most, and they gathered an immense fleet. Don Juan of Austria, Phillip's half brother, just then the popular military hero of Europe because of his recent success in a crusade against the Moors, was in command. The Christians met the Turkish galleys in the Gulf of Lepanto on the western coast of Greece and utterly defeated them. This broke the power of the Turks on the sea forever. Though in the next century, the Turks advanced as far as Vienna and besieged the city, they were never the real danger to Europe that they had been before Lepanto. Besides the commander-in-chief, the one name now remembered from the battle is that of Cervantes, the author of 'Don Quixote.' He was wounded while bravely fighting, though on the morning of the battle the physicians had ordered him to stay in bed because he was suffering from fever. He was very proud of his wound and liked nothing better than to be known as «the maimed soldier of Lepanto.» He was afterward captured and sold as a slave among the Mohammedans. This slave making continued, though in ever-decreasing importance, until the young American republic, at the beginning of the 19th century, inflicted severe defeat upon the Mohammedan pirates.

The best-known event of the century, because of the endless disputes as to its significance, is the massacre of Saint Bartholomew's Day in Paris, 24 Aug. 1572. A great many Huguenots were murdered under the direction of the government, with sad disgrace to France. Catherine de'Medici, the widow of Henry II, and the mother of the three kings who succeeded each other rapidly at this time, Francis II, Charles IX and Henry III, is undoubtedly responsible for it. Since Ranke's declaration on the subject, most historians have agreed that there was no deliberate premeditation of the massacre. Catherine was angered at Admiral Coligny and in a spirit of revenge resolved to do away with him. Assassination by governmental order was still not repudiated in most countries. Coligny's assassination was attempted 22 August, but failed. In her alarm over the failure, Catherine worked upon the fears of her son, Charles IX, that the Huguenots might in revenge bring about counter attacks and had him order a massacre in which Coligny would surely be included. Only the leaders of the Huguenots were to have been put out of the way, but in the mob spirit that ensued a great many others were killed. Many rich people became victims, their houses being pillaged regardless of their religious opinions. Mezeray declared that to have money or enviable position, avaricious heirs made almost any one a Huguenot at this time. The number of the victims is not known. Ranke estimated that 2,000 fell in Paris and larger estimates than this are undoubted exaggerations. The 'Martyrologie des Huguenots' mentions less than 1,000 dead. There had been religious wars in France between the Huguenots and Catholics in 1562–63, 1567–68 and 1569–70, and it was hoped that this might put an end to the civil strife, but it only inveterated it. Lyons, Toulouse, Bordeaux and Rouen all had massacres later than Paris, Toulouse 23 September, Bordeaux, 3 October. The lack of simultaneity shows that the massacre had not been planned but was a sudden decision. Charles IX sent a message to his Ambassadors throughout Europe: «Coligny and his followers were all ready to visit upon us the same fate that we dealt out to them.» The French magistrates ordered thanksgiving every year on 24 August in gratitude for the timely discovery of the conspiracy. The Pope, told that the French king and his family had been saved from a conspiracy, ordered thanksgiving, but when he learned the truth he refused to receive the man who had fired on Coligny, saying, «He is an assassin.»

At the beginning of this century the condition of the people generally may be judged from conditions in England a generation before. Fortesque, Lord High Chancellor, gives a striking picture of the times quite incredible but for his authority. He said «The inhabitants are rich in gold, silver and in all the necessaries and conveniences of life. They drink no water unless at certain times, upon a religious score, and by way of doing penance. They are fed in great abundance, with all sorts of flesh and fish, of which they have plenty everywhere; they are clothed throughout in good woollens, their bedding and other furniture in the house are of wool, and that in great store. They are also well provided with all sorts of household goods and necessary implements for husbandry. Everyone according to his rank, hath all things which conduce to make mind and life easy and happy.» By the end of the 16th century religious conflict had sadly disturbed social conditions. The rights of the people were trampled under foot and the hard won privileges of the Middle Ages were lost. Such social institutions as the guilds, hospitals and various organizations for the care of the needy suffered most. The decline in social service which began in this century reached a climax that brought reaction only in the 19th century. Education suffered almost as severely as social organization for the times were too disturbed to permit of proper attention to intellectual matters and religious controversy consumed mental energies.

JAMES J. WALSH,

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PRINCIPAL EVENTS OF THE SIXTEENTH CENTURY.

1500-01. Portuguese discover Brazil.
1502. The island of Saint Helena discovered.
1509. Henry VIII of England began to reign.
1515. England and Scotland at war. The battle of Flodden.
1517. Martin Luther began the Reformation in Germany.
1519. Leonardo da Vinci dies.
1520. Raphael dies.
1521. Luther at the Diet of Worms. Turks take Belgrade. Henry VIII of England is titled Defender of the Faith by the Pope.
1522. Circumnavigation of the world completed by Magellan.
1524. Verrazano entered New York Harbor. Holbein the Elder died.
1525. Francis I, king of France, taken prisoner at the battle of Pavia.
1527. Rome taken and sacked by the French under the Constable of Bourbon.
1528. Dürer, the renowned German artist, dies.
1529. Henry VIII quarrels with the Pope over his refusal to grant a divorce.
1533. Henry VIII of England divorces Catherine of Aragon and abolishes papal authority in England.
1534. Ignatius Loyola founds the Company of Jesus.
1535. Church of England founded. Sir Thomas More beheaded.
1536. Printing introduced in Mexico.
1539. The Bible printed in English. Monasteries suppressed in England and Wales.
1543. Copernicus published his theory of the rotation of the earth round the sun.
1545. The Council of Trent began 13 December and lasted 18 years.
1546. Socianism sprang up in Italy.
1547. Cervantes, the celebrated author of Don Quixote, born.
1551. Universities of Mexico and Lima chartered.
1553. Queen Mary restores Roman Catholicism in England. Servetus burned at Geneva. Rabelais dies.
1557. Charles V of Germany resigns the crown.
1558. Elizabeth becomes queen of England and restores the Protestant Church. France recovers Calais from the English.
1560. Presbyterianism established in Scotland.
1564. Michelangelo, the most prominent artist of the Renaissance, dies. Shakespeare born. Vesalius, the father of modern anatomy, dies.
1564. Puritan party founded in England.
1566. The 39 articles of the Church of England formulated.
1568. Mary, Queen of Scots, imprisoned in England. The Reformation introduced in the Netherlands.
1571. Benvenuto Cellini, the famous Italian sculptor, dies. Defeat of the Turks at the battle of Lepanto.
1572. Massacre of Saint Bartholomew in Paris.
1576. Titian dies.
1580. Sir Francis Drake sailed around the world. Camöens the great Portuguese poet dies.
1582. Pope Gregory adjusts the Julian calendar and advances 5 October to 15 October in Catholic countries.
1585. Raleigh established the first English colony in America.
1587. Mary Queen of Scots beheaded. Drake destroys 100 sailing ships in Cadiz Bay.
1588. The invincible Spanish Armada destroyed by the British. Duke of Guise assassinated.
1589. Henry IV of France begins to reign.
1590. Battle of Ivry. Jansen, a spectacle maker in Germany, invents the telescope.
1591. Watches introduced in England from Germany.
1594. Palestrina, founder of modern music, dies.
1595. Tyco Brahe defines the obliquity of the ecliptic.
1598. Edict of Nantes. Tyrone's rebellion in Ireland.
1600. Incorporation of the East India Company.

SIXTH CENTURY. This century was a time of sad confusion and distress, but in the midst of it the first hints of the beginnings of modern Europe as we know it may be traced. The Franks succeeded in establishing themselves under Clovis in a kingdom which embraced a considerable part of what we now call France and Germany. The country was unsettled, and though Clovis and his people were formally converted to Christianity, the process of real Christianization had only just begun. The Vandals, originally a Germanic tribe from the regions near the Baltic Sea, after their invasion of Italy, moved over into Spain and conquered a kingdom there, the word Andalusia being a modification of their name, but they were pushed out of the peninsula by the Suevi and the Visigoths and then established a kingdom in northern Africa. Their original removal from their homelands on the Baltic had probably been due to the intrusion of Slavonic tribes coming from the east and north of them, who in their progress also dislocated the Lombardi (Lombards). These made their way down into Italy and have left their name on the northern portion of it. At the close of this century, the northwestern part of what is now Spain and Portugal was the kingdom of the Suevi, the rest of the peninsula with southwestern France being the kingdom of the Visigoths (West Goths). Northern Italy, Austria and the northwestern Balkan States constituted the kingdom of the Ostrogoths (East-Goths), the Franks held a kingdom stretching along the Channel and including northern and eastern France and most of the Netherlands, while the kingdom of Burgundy represented central and eastern France. The Britons of Celtic origin, under separate rulers, occupied southwestern England and what is now known as Brittany in France. These kingdoms of the barbarians were not, as might be supposed, always disturbed dominions, for one of the greatest rulers of this century is Theodoric of Verona (Dietrich of Bern of the German legends) who ruled the Ostrogoths in Italy (493-526) and gave that unhappy country, whose fairness attracted the barbarians, its one generation of quiet and prosperity since the death of Marcus Aurelius. Before the 6th century closed, men told of Theodoric's reign in Italy the same story that was told in England of Alfred's time, that law was so well enforced that gold pieces could be left on the highway without being stolen. The kingdom established by him lasted scarce a quarter of a century after his death. It was overthrown by the armies of Justinian, and Italy was once more united with the Eastern Empire 553.

The statesman of the century is Cassiodorus, born in southern Italy about 490, died about 583. He attracted the attention of Theodoric by a panegyric on that monarch who in recognition appointed him quæstor when he was about 21. Cassiodorus continued to be the councillor of that king until his death in 526 and then became prætorian prefect under the regency of Amalswintha. The Goths in Italy were being overcome by the Eastern Empire, however, and Cassiodorus at the age of 50 decided to retire. Some years before Benedict had founded his great monastery at Monte Cassino and following his example Cassiodorus founded a monastery on his estate at Vivarium. Here he continued to write for more than 40 years. He gathered together a large library of books, encouraged the monks in their use, outlined studies and by example as well as precept gave a great impetus to classical scholarship. Having during his public career tried to reconcile the two races, the Goths and the Romans, in his religious retreat he labored with greater success to harmonize the culture of the ancient and the Christian world. He had broad, deep interests in all departments of artistic effort and deeply influenced the music of the time. His work 'Institutiones Musicæ' is particularly valuable for the knowledge of the early beginnings of the music of the Church. With his contemporary Bœthius he is the chief exponent of the theory of music between antiquity and the early Middle Ages. The man of Theodoric's reign whose personality lived on to affect men deeply is Bœthius (475–524). He was the greatest intellectual genius of the period and his writings widely influenced the students of a thousand years until the end of the Middle Ages. He was put to death by Theodoric on a charge of treason, though it seems likely that there were religious motives involved — Theodoric was an Arian — and Bœthius is often hailed as a Christian martyr. His 'De Consolatione Philosophiæ' was the most read book of the Middle Ages. It was translated by King Alfred (9th century) and by Chaucer (14th century) and influenced Dante more deeply than any other book except the 'Summa' of Aquinas. It has the interest of Marcus Aurelius' 'Meditations' and while containing no reference to formal religion was a not unworthy predecessor of Thomas à Kempis.

The greatest ruler of the century is Justinian (483–565) surnamed the Great, the Byzantine emperor (527–565). His reign was stormy partly from internal dissensions, but mainly because of the incursions of the Persians who had to be bought off at first (531). His generals surpressed the rebellion at home, though not before Constantinople had suffered severely, and then conquered the Vandal and Ostrogoth kingdoms in Africa and Italy, restoring these countries as provinces of the empire. Belisarius saved the empire by his thorough defeat of the "Green" party,— the name was adopted from a horse racing faction — at Constantinople in 532, overthrew the African Vandals (534), conquered Sicily (535), southern Italy (537), recaptured Ravenna (540), defeated the Persians (541–542), rescued Constantinople from the Bulgars (549). His victories aroused the jealousy of Justinian and Belisarius was imprisoned for a time, though the story that in old age he was obliged to beg his bread is false. Freeman declared him the greatest of military commanders in history, with Hannibal as his only rival. Belisarius was thoughtful of others in his hour of triumph for his name is connected with the foundation of a hospital at Rome about the middle of this century. Pope Symmachus had set the fashion for such foundations by establishing a hospital in connection with the three most important churches of Rome, Saint Peter's, Saint Paul's and Saint Lawrence's; as all three were situated well out of the city proper they presented ideal locations for hospitals. The example thus set was followed in many cities in France and in various places in England, after Saint Augustine's missionary work began to have its effect.

Even more than as a great ruler Justinian is forever famous as the promulgator of the code of law since usually called by his name. The 'Corpus Juris Civilis' (Body of the civil law of Rome) published by him comprised all the law knowledge of the ancient Romans and as we realize now was the most precious legacy of Rome to the world. Justinian deserves because of it the title of "law giver of civilization."

Justinian's worthy monument and a striking symbol of the creative artistry of the time is the church of Santa Sophia in Constantinople, still standing as unimpeachable evidence of constructive genius and love of the beautiful. The church is almost a square (250 by 230 feet), above which there is an enormous dome over 100 feet in diameter. This central dome represents the solution of an architectural problem of the greatest difficulty. The church was completed under Justinian (537) and Procopius a contemporary declared that the dome had the appearance of being suspended in the air "by a golden chain from heaven rather than of resting upon solid masonry." The interior decoration was in richly carved colored marbles, while mosaics covered the wall space left free and adorned the vaulting above. The pavement composed of jaspar, alabaster, porphyry and serpentine formed a veritable carpet of many colors. The effect according to a contemporary was that of "a garden, its lawns enameled with flowers" . . . "The altar was a marvel in itself. The mensa was entirely of gold, sparkling with jewels and glowing with enamels. It rested on columns also made of gold, while over it, four columns of silver supported a domed canopy surmounted by a great golden cross. Around the altar hung curtains of wonderful tapestry of silk and gold wherein were depicted Justinian and Theodora venerating Christ and His Mother. At the end of the apse, rose up the patriarchal throne of silver and gold."

The architect of Santa Sophia was Anthemios of Tralles, sometimes said to have been brother of Alexander of Tralles, the author of a well-known treatise on the pathology and therapeutics of internal diseases which was evidently a compilation of material gathered for teaching purposes. It is one of the landmarks of medical history. Alexander says "The physician should be an inventor and think out new ways and means by which the cure of the patient's affection and the relief of his symptoms may be brought about." He took strong ground against the use of many drugs and the rage for operating. The prevention of disease is for him the important part of the physician's duty. Diet, air and water were his great remedies; for consumption he recommended milk, strong nutritious diet and a sea voyage or a stay at a watering place.

Pope Saint Gregory I the Great (540–604) is one of the important characters in this trying time around whom the forces of the new life that was to come for Europe gathered. Among his close friends were Saint Augustine whom he sent on a mission to England, though the story of the English boy captives in Rome, "*Angeli non Angli*"— Angles who looked more like angels — is dubious; and Saint Benedict and his sister, Saint Scholastica, who were destined to a very great work, the influence of which was to be felt for many centuries, even down to our own time. Gregory had been in the Roman civil service as *prætor urbanus*, but turned to the ecclesiastical state and employed the fortune left him at his father's death to establish a series of monasteries. As Pope (590–604) he restored discipline among the monks and clergy, arranged the Gregorian chant in church music which is still used and was zealous in the spread of Christianity. He wanted to go as a missionary to Britain in earlier life, but was prevented by the Pope who foresaw his higher destiny; later he inspired Augustine with his own zeal. He and Pope Leo I (circa 460) are the great popes of the transition from ancient to mediæval Church. Gregory's friend Benedict, known as Nursia from the place of his birth, is the founder of monasticism in the West. He was the son of a Roman noble whose boyhood was spent in Rome where he attended school until he reached the higher studies. At the age of 20, about the year 500, disgusted with the loose life around him, he withdrew from Rome to find a place of peace and recollection. At first he took a servant with him, but he found after a while, that he needed manual labor to keep him in good health. Attracted by his gentleness and by the refuge from the madding crowd around them which his little retreat offered, many others came to join him, until Benedict found that his own peace of mind and heart was sacrificed, so that he fled further to live alone. He learned enough in three years of solitude to make him appreciate how much this retired mode of life might mean to others, for their personal development, and so (when the fame of his gentle saintliness having gone abroad) he was asked to be the head of a monastery, he consented. Here he drew up his famous Rule, which has served as the constitution of the Benedictine houses ever since, and which authorities in the history of law hail as a great foundation-stone of modern jurisprudence. His monasteries were arranged to provide opportunities for prayer, recollection, study, besides such labor as would keep the body in good condition. Men of all classes, even of the nobility and of reigning families, joined his communities and gave the example of laboring with their own hands. They restored the dignity of manual labor which had been undermined by the slave labor which had absorbed all manual work at the end of the Roman Empire. The monks gave themselves assiduously to the copying of manuscripts of the ancient authors and the exchange of these copies led to the formation of a number of monastic libraries through which the classics have been preserved for us. Each monastery had a school attached to it where the boys of the neighborhood and sometimes even from a distance were taught; and sons of the nobility often spent some years in these monastic schools. The solution of the social problems of the country places became the special task of the monasteries.

They were, besides, centres around which there gathered a numerous tenantry who worked the lands of the monasteries, which were mainly gifts and bequests from kings and nobles who realized how much good was being accomplished by the monks, and who hoped thus to make up for evil in their own lives by foundations which would continue to do good. Monasteries, quite contrary to the tradition of «lazy monks,» of a generation ago, were really hives of busy industry. It is only since we have established agricultural schools that the realization has come that the old monasteries represent an anticipation of these schools (Goodell Presidential Address Massachusetts Agricultural School). For the tenantry were taught how to raise their crops to the best advantage; good breeds of stock and seeds which would grow to the best advantage under the conditions were provided for them. The monastery itself diked, ditched and drained the territory, often brought water from a distance for irrigation. It was no wonder that the tradition arose that it was «happy to live under the crozier,» that is under the rule of an abbot or abbess, for the convents for women shared all of the privileges and advantages of the monasteries for men. These monasteries became centres of trade and industry as well as of education and of letters. They cultivated particularly architecture and the arts of painting and sculpture, but also the minor arts and crafts, so that beautiful wood work and iron work, as well as carving in stone and stained glassmaking, were developed to a high degree, while the convents accomplished similar artistic purposes in lace-making, needle-work, tapestry, book illumination and like occupations.

The Benedictine nuns were founded by the twin sister of Benedict, Scholastica by name, and the nunneries came to be refuges for women who wished to pursue an intellectual and spiritual life, similar to that which the monasteries provided for the men. At all times in history, a certain number of women do not feel the vocation to be wives and mothers and to assume family cares. Some provision must be made for them and the failure of such provision brings serious social evils in its train. For centuries these Benedictine nunneries provided an opportunity for these women and besides accomplished wonderful work. Mrs. Putnam (dean of Barnard College) goes so far as to say that the modern college for women has not as yet provided opportunities for the exertion of woman's influence equal to those given her by the Benedictine nunneries in the Middle Ages. We know almost nothing of the life of Saint Scholastica, except the famous story told by no less an authority than Pope Saint Gregory I, that when she came to die and her brother, who was with her, was about to leave, in order to keep his own rule that no one unless compelled should stay out of his monastery over night, Saint Scholastica prayed that he might be kept near her, and a great storm arose which prevented Benedictine from leaving her side until after her passing. Her convents, like the monasteries of Saint Benedictine, are still in existence all over the world, many of them very flourishing and all engaged in good work. The word «nun,» originally *nonna* or *nanna*, was a form of the word «mother,» because these women who denied themselves personal maternity became the mothers of the needy all around them.

As the result of the large number of slaves which had accumulated in Roman times, the Middle Ages began with the very serious handicap of an immense problem of serfdom. During the first century of the Christian era, when Rome had a population of about 2.000,000, it has been calculated that about 1,200,000 of them were slaves. This state of affairs grew worse with time. The condition was not so bad in country places, but opportunities for becoming freemen were much commoner in urban than in rural life, though everywhere progressive individuals were able to secure their freedom in one way or another. The defeats of the barbarous peoples in preceding centuries led to the capture of many prisoners who were made slaves, and these were distributed throughout the country places and their descendants were serfs. By this was meant that they were bound to a condition of service, though their masters were bound also in certain obligations toward them. These serfs went with the land whenever it was transferred, and as the land was divided into manors or villas (Latin for a country estate), they were called villains. This word afterward became villain in our sense of rascal, because serfs who ran away from their masters so often found themselves under the necessity of making their living as best they might, by their wits or even by violence.

The serf belonged to the land but the land owed him a living. In a certain sense, therefore, he was better off than the lowest classes have been since the industrial revolution. While some masters were harsh, a great many of them tried to make conditions reasonable for the workers, and persons of special talent and energy who were able to make their own way could usually obtain their freedom. If a serf were absent from his master's domain for a year and a day, the master had no further claim on him. The brighter boys from the country went into the towns, rose from apprentices to membership in the guilds and thus secured their rights as freemen. At this time, no one was supposed to have any rights unless they had been specifically conveyed to him by some authority. This condition of villainage continued for centuries, the conditions of it being gradually ameliorated. Villas or manors were transferred by bequest or gift to monasteries or convents and the serfs on these were treated so well that it came to be a tradition that it was good to live on the domains of abbot or abbess. Their children sometimes entered the convents and monasteries and were given the opportunity to rise. Some of them became priors or abbots and sometimes bishops, and occasionally the descendant of a serf might be made Lord Chancellor of the kingdom. The presence of all these serfs or slaves to whom the hard manual labor of the time was entrusted made the doing of manual labor by others seem disgraceful, and it was not until the foundation of the monks of the West with the provision of the Benedictine Rule for manual labor by all, that the dignity of labor was restored. It took centuries of Christian effort to bring about a definite improvement in social conditions in this regard.

While Benedict's foundation was gathering strength the 6th century is full of the labors of the Irish monks. Zimmer declared «The Irish missionaries were instructors in every known branch of science of the time, the pioneers who laid the corner stone of Western culture on the continent.» The greatest of them is Columba of Iona (521–597). Scarcely less great is Columbanus of Bobbio, though the work for which he is best known was done in the next century. Columba left Ireland in his 44th year, landing at Iona on the eve of Pentecost 563. From here he began the conversion of the Northern Picts. He wandered far and wide on foot through the land and is said never to have spent an hour without study, prayer, writing or some similar occupation. He himself transcribed many books. In spite of incessant labors, fasting and vigils, sleeping his scanty sleep often on a stone pillow, like so many other of the intensely hard workers of human history, Columba lived to the round old age of nearly 80. He was not only a great missionary saint who won a whole kingdom to Christ, but he was «a statesman, a scholar, a poet, the founder of numerous churches and monasteries when monasteries corresponded to our colleges, and his name is dear to Scotsmen and Irishmen alike.» To him we owe a famous decision as to books that the owner of an original had the right over the copies, for «to every cow its calf,» which represents the basis of copyright.

The end of the century witnessed the installation of Saint Augustine (Austin) as archbishop of Canterbury (598). He was a Roman who became a monk and a personal friend of Pope Gregory the Great. In his desire to carry out a great missionary project among the Angles, or English,— the Britons had Christianity before this,— Gregory sent Augustine to England and gave him jurisdiction over all the bishops on the island. His mission was eminently successful. Aethelbert the king, who had married the daughter of Charibert of Paris with the condition that she should be allowed to exercise her Christian religion freely, was converted and his people soon followed him. Quite contrary to the spirit sometimes displayed, Bede tells us that it was part of the king's policy «to compel no man to embrace Christianity.» On Christmas Day 597 more than 10,000 persons were baptized by the first archbishop of the English. England was thus placed once more in touch with Roman culture. «The civilization, art, letters, which had fled before the sword of the English conquerors returned with the Christian faith.» (Green).

When Augustine landed he brought with him Roman customs and as certain traditions had grown up in the British and Celtic churches not in accord with those of Rome, particularly as to the date of Easter and the form of tonsure, jealous rivalry ensued and it seemed for a time as though there might be actual division. A synod was called at Whitby (7th century) and through the influence of the king the dispute was brought to an end and England was won to the Roman side.

The characters of the men among whom Columba and Augustine had to do their missionary work is well illustrated in the poem known as 'Beowulf,' the first English epic which was written probably some time toward the end of this century. Beowulf was a kinsman of Hygelac who appears in Gregory of Tours' *Gesta Regum Francorum*. He lived in the early part of this century and the myths that gathered around Beowulf's name were probably put into nearly the form in which we now have them in immediately succeeding generations and represent our earliest Old English literature. The epic is pagan and barbaric, full of the lust of blood, and yet it has a stirring appeal to deep human interests that accounts for its survival. The prose writers of this first century of the Middle Ages whose works have come down to us are more numerous than might be thought. Procopius, a Roman historian, is often spoken of as the last of the classic writers. The end of the century saw such well-known historians as Gregory of Tours, the father of French history, Gildas the first British historian, Evagrius ecclesiastical historian, and Cassiodorus of Ravenna, the minister of Theodoric.

James J. Walsh,
Author of ‘The Thirteenth Greatest of Centuries.’

Principal Events of the Sixth Century.

510. Clovis, king of the Franks, makes Paris his capital.
520. Hygelac, the Danish hero of the "Beowulf" epic, killed by Franks in a naval battle.
524. Boethius, author of the "Consolations of Philosophy," put to death by Theodoric.
525. An earthquake destroys Antioch.
526. Death of Theodoric, king of the Ostrogoths.
527. The Justinian Code published.
529. Belisarius defeats the Persians.
532. Belisarius overthrows the "Green" party at Constantinople.
534. Belisarius defeats the African Vandals.
535. Belisarius conquers Sicily.
536. Belisarius captures Rome and occupies southern Italy.
537. The church of Saint Sophia at Constantinople completed.
541–542. Belisarius defeats the Persians.
548. Justinian invites the German Longobards or Lombards to Italy to aid him against the Ostrogoths.
549 Belisarius rescues Constantinople from the Bulgars.
550. Huns and Slavs invade Italy.
551. The silkworm introduced into Europe.
554. Greek domination supreme throughout Italy.
556. Earthquake devastates Constantinople.
563. Columba leaves Ireland and lands at Iona.
565. Justinian the Great dies.
565. Procopius, the Roman historian. dies.
568. Lombards occupy northern Italy, and Greek rule is confined to southern Italy.
570. Birth of Mohammed.
570. Gildes, the first British historian, dies.
572. War between the Byzantines and Persians.
583. Cassiodorus of Ravenna, the former minister of Theodoric, dies.
590. Gregory the Great became Pope.
594. Gregory of Tours, the father of French history, dies.
597. Columba of Iona dies. On Christmas Day 10,000 persons were baptized by Saint Augustine.
598. Saint Augustine becomes archbishop of Canterbury.
599. Pope Gregory the Great institutes Church reform.
600. Evagrius, ecclesiastical historian, dies.

SIXTUS, sĭks'tŭs, the name of five popes, as follows:

SIXTUS I, Saint (also written Xystus). He succeeded Alexander I, about 119, and suffered martyrdom about 127, after 10 years rule.

SIXTUS II, Saint: d. 258. He succeeded Stephen I in 257, and according to some accounts was an Athenian philosopher before professing Christianity. He was martyred during the persecution of the Christians by Valerian, and is the Xytsus commemorated in the Canon of the Mass.

SIXTUS III, Saint: d. 440. He succeeded Celestine I in 432. He was active in attempting to reconcile the disputes existing in the Eastern Church, particularly in the case of Cyril, bishop of Alexandria, and John of Antioch. Several letters by him with regard to those controversies are extant. He was a munificent patron of learning, and is stated to have left a large sum to be expended in the adornment of ecclesiastical structures.

SIXTUS IV (Francesco della Rovere, fràn-chĕs'kō dĕl'lä rō-vā'rā): b. Savona, 21 July 1414; d. 12 Aug. 1484. He was the son of a Genoese fisherman, and entered the Franciscan order, where his learning and eloquence soon attracted attention. His abilities secured him the chair of divinity at Padua and other Italian universities, and he also became general of his order. He was made cardinal by Paul II, whom he succeeded in 1471 through the influence, it was supposed, of Cardinal Bessarion, whose close friend he was. He was an enlightened patron of art and during his occupancy of the papal chair the Sistine Bridge was erected and the famous Sistine Chapel. Many of his relatives were advanced to high places of profit by him, and for this and certain acts of treachery he was much criticised, but R. Urban Butler states, in ‘The Catholic Encyclopedia,’ “the gross accusations brought against him by his enemy Infessura have no foundation.” He reformed the papal coinage and did much to improve and beautify Rome.

SIXTUS V (Felix Peretti, fā'lēks pā-ret'tē): b. near Montalto, 13 Dec. 1521; d. Rome, 27 Aug. 1590. His boyhood was spent as a swineherd; but, giving early indications of an aspiring disposition, he was admitted to the Franciscan order in 1534, and received the usual strict education and instruction of the monasteries. In 1544 he gave instruction in the canon law at Rimini, and in 1546 at Siena. In 1548 he was made priest, doctor of divinity and superintendent of the monastic school of Siena. In 1556 he removed to Venice, where he was appointed superintendent of the Franciscan school, and afterward inquisitor-general. In 1560 he was recalled from Venice, owing to his severity as inquisitor, and proceeded to Rome, where the Pope conferred upon him several dignities. Some years later (1565) he attended the papal legate to Spain as the theologian of the embassy, and while here acquainted himself with the policy of the Spanish court. In 1570 he was made cardinal by Pius V. He was elected to the papal see in 1585, and during his five years' administration devoted himself with great vigor to the reform of abuses both civil and ecclesiastical. Under his immediate predecessors, Pius V and Gregory XIII, the civil disorder was excessive in the states of the Church, crimes had gone unpunished and hordes of brigands infested the whole country. All this was now remedied, stern justice was administered on all hands, the country cleared of robbers and under the security thus produced agriculture, commerce and industry flourished anew. Sixtus founded a new university at Fermo, and new colleges at Rome and Bologna; and embellished Rome with numerous and useful structures, among others the present building of the Vatican Library. He published a new edition of the ‘Septuagint’ in 1587, and one of the ‘Vulgate,’ with improvements, in 1590, besides corrected editions of the Church Fathers. He displayed the same energy in the spiritual administration of the Church, re-established discipline in the religious orders and founded or reformed several congregations of cardinals and other officers. He fixed the number of cardinals at 70. He took a part in most of the great events that then agitated Europe. He encouraged and supported Henry III against the Huguenots, Philip II against England, and Archduke Maximilian when he was a candidate for the Polish crown. The great aim of his foreign policy was the promotion of the cause of Roman Catholicism throughout all Christendom against Protestantism.

SIZAR, a term used in the University of Cambridge, and at Trinity College, Dublin, to denote a class of students of limited means who usually receive their commons free and are pecuniarily assisted otherwise. They were originally required to perform certain duties of a menial character, but this practice has long ago fallen into desuetude. Formerly there was a similar class of students at Oxford called servitors of battelers.

SIZE, a gelatinous material used to give a glaze to a surface. There are numerous formulas for its manufacture, differing according to the purpose, cost of ingredients, etc. Gilders use a viscous preparation as a size to hold the gold leaf; an albuminous printing ink is made to hold bronze powders; house-painters' size may be prepared from shreds of leather boiled and strained; papermakers use two kinds, one made from hide cuttings, alum and soap, and a second of rosin and potash; and the size employed in gilding, japanning, etc., is variously composed of linseed oil, copal, red leather, litharge, vermillion, etc., with turpentine.

SJÖSTEDT, shēs′tĕt, **Ernest Adolf,** Canadian mining and metallurgical engineer and inventor: b. Sweden, 1840. He was graduated at the Royal School of Mines, Stockholm, in 1876, and came to the United States in 1877. He was assistant chemist at the Bethlehem Steel Works, Pennsylvania, in 1877–79, and in 1879–96 he was connected with the iron-smelting industry in Maine, Georgia and Nova Scotia. In 1896 he established himself at Montreal as a designer of roasting furnaces and gas producers; and in 1898 he became chief metallurgist of the Lake Superior Power Company at Sault Sainte Marie. He invented the Davis-Colby iron-ore roaster; the Sjöstedt sulphide roaster; the Sjöstedt electric smelting furnaces, and the Sjöstedt-James electrolytic process for the separation of copper and nickel.

SKAGEN (skä′gĕn) **CAPE,** or **THE SKAW,** skâ, Denmark, the extreme northern point of Jutland. It is a low sand bar or narrow tongue of land and near its extremity is an important lighthouse.

SKAGER RACK, skăg-ĕr-răk, or **SKAGERRAK,** the broad channel connecting the North Sea with the Kattegat, and separating Norway from Jutland. It is about 150 miles long and 100 to 125 miles wide. Its southern part is shallow and beset with sand-banks, but it is very deep along the Norwegian coast. Its navigation is dangerous on account of frequent and violent storms.

SKAGWAY, skăg′wā, or **SKAGUAY,** Alaska, city at the northern end of Chilkat inlet, at the head of Lynn Canal. It is at the entrance to White Pass and near Chilkoot Pass, about 270 miles north of Sitka. It is on the White Pass and Yukon Railroad, which with other railroads and with water routes makes a continuous rail and water route from Skagway to Seward Peninsula. There were trading stations in the vicinity, and it may be on the site of the present city, but they were established and abandoned to suit the needs of the traders. The settlement of the present city began in 1897 when a miner from Minneapolis, Minn., opened a wagon road across White Pass from the Canadian gold fields. From a town of tent-cloth dwellings it has become a prosperous little city, with manufactories and stores to meet the demands of a large number of the mining camps of the interior. In 1899 a college was established with Dr. La Motte Gordon, an Oxford graduate, as president, and with 50 pupils in attendance. There are public schools and Presbyterian, Roman Catholic, Protestant Episcopal and Methodist churches. Pop. about 3,500.

SKALD, skâld or skōld (in Old Norse Skâld, poet), one of the Norse poets who in primitive times recited long compositions in verse, usually in honor of the great and famous. They were minstrels of a high order, often attached to the court. The earliest of these skalds was the mythical Starkadh the Old. The following are the most famous of his successors: Thjodolf, author of 'Ynglinga-tal'; and Thorbjorn the minstrel and author of 'Haraldsmal,' both of whom flourished at the end of the 9th century at the court of Harold of the Bright Hair. In the 10th century lived the Norwegian skald Eyvind who sang the exploits of the famous 'Hakonar-mal'; and the Icelander Egil, who gave his name to the Egils-Saga. More obscure were Hallfredh, Gunlaug, Glum, Eyjolf, etc. The last of the skalds was Skurla who died 1284. Consult Grendal, 'Clavis Poetica' (1864); Baldisarson, 'Islendingadrapa' (edited by Möbius, 1874); Wisen, 'Carmina Norroena' (1889); Anderson, 'Norse Mythology' (1875).

SKARPANTO, skär′pän-tō, or **SCARPANTO.** See Carpathos.

SKAT, an intricate game of cards originating in Germany about the year 1800. Thirty-two cards are used and three or four persons take part in the game, although but three are active players. The interest is maintained largely by bidding for the privilege of play. Each player holds 10 cards, two being laid aside for the "skat." The use of these two cards determines the game. For a complete description of the game consult Hoffman, 'Book of Skat'; Eichhorn, 'American Skat.'

SKATE. See Ray.

SKATES AND SKATING. Ice skates are made in many forms, the most common having a metal blade or runner, longer than the foot, with some sort of frame or mechanism for attaching to the shoe. The object is to provide a support on which each foot of the wearer can slide or glide on the ice, this method being by far the most rapid means of travel over a frozen surface by the individual's own exertions. Skating is undoubtedly of great antiquity; as shown by early carvings. It is mentioned in the Icelandic 'Edda,' supposed to have been written in the 10th or 11th century. Primitive skates were made by tying smooth bones of animals to the foot-coverings. The earlier forms were mainly of wood, with a metal runner. This runner was gradually improved until it became a blade of hard steel with a slightly up-curved front. The wooden-bodied skates of the 19th century were universally tied on to the foot with leather straps, passing through slots in the wood. As they were improved a sharp point was placed in the rear of the skate to cut into the shoe-heel and prevent slipping; later a screw took the place of the point. Then came the club-skate, all metal, with clamps for gripping the sole of the shoe and a gripping mechanism to engage a steel plate permanently fastened on the heel of the shoe. Fancy skates were made with long ornamental up-curve of the runner in front. The racers developed a different type with a long runner, almost straight, though slightly raised above the level in front. This was found so superior that it was adopted by all speed skaters and many amateurs. Finally came the skating boot, a well-made strong boot, with the runner directly attached to the sole. This has been generally adopted by figure skaters and racers.

Skating was developed in the cold countries of the north, both as a pastime and as means of getting about rapidly. In the Netherlands the canals made convenient highways in winter, and have been used by skaters for hundreds of years. The earliest record of a skating club is in Edinburgh, Scotland, in 1642. The British National Skating Association was formed in 1879. The American National Skating Association was organized in the United States in 1884, and the Canadian Amateur Association in 1886. There are now also the Eastern Amateur Skating Association, the International Skating Club of America and the International Skating Union of America. Matches were held, however, long before the time of these associations. The first recorded English match was in 1823. Newburgh, N. Y., furnished the first American champion skater, Charles June, who was the recognized speed champion for many years. In those days the skaters used a short runner and took long strokes of 10 to 12 yards. All this was changed by the Donohues of Newburgh, regarded as the greatest family of skaters in the world, having produced three champions. T. Donohue, the elder, first beat all comers and educated his sons to the sport, and J. F. Donohue and T. Donohue, Jr., in turn took world's records. They developed the long runner skate and the short stroke, and J. F. Donohue attended the international meet at Amsterdam in 1891, and astonished them by his short quick strokes of six or seven yards, easily beating all contestants.

Figure skating, by some called fancy skating, appears to have had its first great impetus in the London Skating Club founded in 1830. Becoming favorably known as a sport, other clubs were organized in Switzerland and northern Europe, and figure skating became a popular sport of the well-to-do. In this branch of skating there is no attempt at speed, the object being first to skim around in loops, cross-cuts, grapevines, two-footed figures and various combined figures in which one of more pairs of skaters take part. It might be called the equivalent of dancing on ice, graceful exercise being the end sought. The British style of figure demands an upright body, and is considered more graceful than the bending over style, though the latter permits some accomplishments not readily done erect. The plain figures are formed on one skate, the unemployed leg being trailed behind, either straight or slightly bent and used to steer and balance.

Records.— Championship matches have become common in all of the northern cold countries. Both indoor and outdoor tournaments have been held in the United States and Canada for many years. Popular tournament places have been Montreal and Toronto, in Canada, and Minneapolis, Milwaukee, Stamford, Conn., Red Bank, N. J., and Saranac Lake and Newburgh, N. Y., in the United States. The amateur records have often surpassed the professional records for shorter distances, probably due to the fact that there are few professional racers. The amateur American records are: 100 yards, Morris Wood, 9 3-5 seconds, in 1903; 220 yards, Fred J. Robson, 18 seconds, 1911; half mile, Ben O'Sicky, 1 minute, 15 3-5 seconds, 1916; one mile, Morris Wood, 2 minutes, 41 1-5 seconds, 1904; five miles, E. Lamy, 14 minutes, 55 seconds, 1910. The world's amateur records are in metres, and from 500 to 10,000 metres, were all taken by O. Mathiesen, of Norway, at various public meets in Europe, between 1910 and 1914, with the following results: 500 metres, 43 7-10 seconds; 1,000 metres, 1 minute, 31 4-5 seconds; 1,500 metres, 2 minutes, 19 1-2 seconds; 5,000 metres, 8 minutes, 36 3-5 seconds; 10,000 metres, 17 minutes, 22 6-10 seconds. The professional American records are: 100 yards, John S. Johnson, 9 4-5 seconds, 1893; 200 yards, John S. Johnson, 17 2-5 seconds, 1893; 440 yards, John S. Johnson, 31 3-4 seconds, 1916; half mile, John Nilsson, 1 minute, 16 1-5 seconds, 1897; one mile, Arthur Staff, 2 minutes, 35 seconds, 1916; two miles, John Nilsson, 5 minutes, 33 4-5 seconds, 1900; five miles, O. Rudd, 14 minutes, 24 seconds, 1896; 10 miles, John S. Johnson, 31 minutes, 16 1-2 seconds, 1894; 20 miles, John S. Johnson, 1 hour, 6 minutes, 36 2-5 seconds, 1894; 25 miles, John Karlson, 1 hour, 30 minutes, 15 seconds, 1916. All records from 30 miles to 100 miles are held by J. F. Donohue, who at Stamford, Conn., in 1893, made the 100 miles in 7 hours, 11 minutes, 38 1-5 seconds. Consult Browne, G. H., 'Handbook of Figure Skating' (Springfield, Mass., 1913); Meagher, G. A., 'Lessons in Skating' (1900). See ROLLER SKATE

SKEAT, skēt, **Walter William**, English scholar and philologist: b. London, 21 Nov. 1835; d. 7 Oct. 1912. He was graduated from Christ College, Cambridge, in 1858, and two years later became a Fellow of his college and curate of East Dereham, in Norfolk. In 1862 he went to Godalming, in Surrey, as curate. He was appointed a mathematical lecturer of Christ's College in 1864 and since 1878 held the Erlington and Bosworth professorship of Anglo-Saxon in the university. Skeat's work in the philology of the English language, especially in its older forms, is of the utmost value and has contributed much to stimulate interest in such studies. His chief original publications in this department are 'A Mœso-Gothic Glossary' (1868); 'Etymological Dictionary of the English Language' (1879-84; revised 1910), his most important work; 'Concise Etymological Dictionary of the English Language' (1882; new ed., rewritten and rearranged, 1901); 'Principles of English Etymology' (two series, 1887 and 1891); 'Primer of English Etymology' (1892), smaller work based upon the preceding, but dealing only with the native element; 'The Chaucer Canon, with a Discussion of the Works associated with the name of Geoffrey Chaucer' (1900); 'Place Names of Cambridgeshire' (1901); and 'Notes on English Etymology' (1901). Among numerous editions of English texts which he has edited for various societies and publishers may be cited 'Lancelot of the Laik' (1865); 'Havelok the Dane' (1868); 'The Vision of William concerning Piers the Plowman' (1886), giving the three texts parallel, with notes, glossary, etc.;

'Ælfric's Lives of Saints' (1882–98); Chatterton's 'Poems' (1871); 'The Works of Chaucer' (with notes, glossary, etc., 1894–95; with a supplemental volume of spurious Chaucerian pieces, 1897); and 'The Student's Chaucer' (1895). He founded the English Dialect Society in 1873, and was its chief member during the 23 years of its existence. For it he prepared several provincial glossaries and upon these and other publications of the society the new 'Dialect Dictionary' is based. 'A Student's Pastime' (1896) consists of articles contributed by him to 'Notes and Queries.' He has also translated Uhland's 'Songs and Ballads' (1864).

SKEE. See Ski.

SKEED. See Skid.

SKELETON, the more or less hard structures, mainly of bony nature, which form the internal axis of support of the soft parts in the higher or vertebrate animals. The term is used in comparative anatomy to designate supporting parts not only of internal, but also of external nature. Anatomists thus speak of an endoskeleton as proper to the vertebrates, but both vertebrates and invertebrates may have certain hard parts developed on the exterior of their bodies (for example, shell of lobster, scales of fishes, etc.), and to the latter class of structures is applied the name exoskeleton. The parts of any endoskeleton may generally be grouped under the two heads of the spinal or axial skeleton and the appendicular parts. The former includes the skeleton of the head and trunk, the latter that of the limbs. The spinal skeleton involves the consideration of the skull (q.v.), spinal or vertebral column, composed of its various vertebræ and of the thorax (q.v.) or chest and pelvis (q.v.). The composition of the skull forms a subject of great intricacy and involves many highly technical considerations. The more general characters of the skull are noted in a separate article (see Skull). The vertebræ or component parts of the spine or backbone consist each of a solid piece or body, attached to which are various processes. The spinal arches spring from the posterior part of each vertebra and unite to form the spinous process; the spinal cord itself being protected within the canal formed by the apposition of the arches of the vertebræ. In man seven cervical or neck vertebræ, 12 dorsal and five lumbar vertebræ exist as separate bones. The sacrum (q.v.) and coccyx, forming the terminal part of man's spine, are composed of united vertebræ. Thirty-three vertebræ are found in the human fœtus normally, but in the adult five of these unite to form the sacrum; while the other four (more or less) form a short tail piece or coccyx, the latter being below the junction with the pelvis. The heavy pelvic bone in man makes a base for the spine and head sockets for the femurs or leg-bones. The ribs in man correspond in number with the dorsal vertebræ. The limbs consist of homologous or corresponding parts and are attached to a series of bones constituting the "arch" or support of the fore and hind limbs respectively. The scapulæ or shoulder-blades and collar-bones or clavicles constitute the shoulder-girdle (see Shoulder-joint), or arch supporting the fore or upper limb, while the lower limb is attached to the pelvic arch or pelvis. The upper limb or arm in man contains 31 bones; the humerus or bone of the upper arm; the radius and ulna, or bones of the forearm; the carpal or wrist bones; the metacarpal bones, or those of the palm; and the phalanges, or bones of the fingers. The lower limb or leg in man contains 30 bones: the femur or thigh-bone; the tibia (shin) and fibula or bones of the leg; the tarsal bones or those of the ankle, corresponding to those of the wrist; the metatarsus or instep; and the phalanges or bones of the toes. (See the illustration of the human skeleton under anatomy, Vol. I). The character and appearance of the bones changes materially with advancing years. The bones of a child at birth are soft and incomplete. They grow, ossify and fuse together in a most interesting manner, so that the dissector can judge approximately of the age of an individual by the condition of the bones.

Invertebrates.— Shell fish have exoskeletons or shells composed mainly of lime or flint, which is absorbed and utilized. The corals (q.v.) produce a formation that is their skeleton. The arthropods or snails have a horny little house or exoskeleton, the cuticle forming from the epidermis with an organic base of chitin on which carbonate of lime is deposited. In the lobster, scorpion and many crabs, the skeleton is partly interior. Most mollusks leave shells in which the carbonate of lime occurs along with an organic base of conchiolin; in the cuttlefish there is a pronounced development of cartilage about the nerve centres of the head, suggesting a basis for a skull.

Vertebrates.— In a primitive vertebrate, as the lancelet (*Branchiostoma Lanceolatum*), the body is supported by a median dorsal axis; and, disregarding slight bony supports for the mouth, the pharynx and the median fin, that is the active skeleton or framework. The median dorsal axis, which in the lancelet has not even the solidity of cartilage, is the notochord, a constant characteristic of all skeletons of vertebrates. This notochord may be likened to an elastic rod that in the embryo is formed under the neural canal, consisting of a longitudinal axis for separating the dorsal nervous tube from the ventral alimentary passage. This notochord in the lancelet, the hog and the young lamprey is an unsegmented rod with a simple sheath. In the adult lamprey there form above the notochord, rudimentary arches of cartilage that maintain the spinal cord. Cartilaginous arches appear both above and below the notochord in the sturgeon, the chimera and the dipnoi, but there are no true vertebræ. These are noted first in the elasmobranch fishes, in which the notochord is more or less constricted by the encroachment of its sheath, and divided into vertebræ. In the bony ganoid fishes, the vertebræ are ossified, as in higher vertebrates. The notochord, therefore, appears a provisional structure or scaffolding around which a backbone can be built. Each vertebræ usually consists of the centrum or substantial body, the neural arches that form a tube for the spinal cord and meet above in a neural spine, the transverse processes which project and are commonly connected with ribs and the articular processes which bind the vertebræ together into a strong but flexible backbone. Birds and mammals and many reptiles have a breast bone or sternum, to which the ribs unite ventrally.

The pectoral or shoulder-girdle consists of a dorsal shoulder-blade or scapula, a ventral coracoid with the articulation for the arm or foreleg between them and of a forward growing collar-bone or clavicle. The pelvic or hip girdle in each side consists of a dorsal ilium, a ventral ischium with the articulation of the leg between them, and of a pubic portion. From amphibians upward, the forelimb is a humerus articulating with the girdle, a lower arm composed of radius and ulna side by side, a wrist or carpus of several elements, a hand with metacarpal bones in the palm, and with fingers composed of several joints or phalanges. The hind limb consists of a femur articulating from the girdle, a lower leg of tibia and fibula side by side, an ankle region or tarsus of several elements, a foot with metatarsal bones in the sole, and with toes of several joints or phalanges. Digits in vertebrates tend to a regular suppression toward the lower types. The pollex goes first, then the minimus index and annularis, so that some animals, as the horse, have one digit (the hoof) remaining. In many of the vertebrates the phalanges are more numerous than in man, as where the hand is modified to form a paddle, notably in the ichthyosauri and the cetacea.

In reptiles the ilium projects rearward, the ischia are often found meeting ventrally, a cartilage or bone projects rearward from the symphysis, supporting the anterior lip of the cloacal orifice, forming a hypoischium. In birds the projection of the ilium is both forward and rearward and it fuses with the vertebral column in the backbone. No union or symphysis is formed by the ischia and pubes in birds, with the exception of the ostrich and rhea. The ilium in mammals projects forward and symphysis of the ischia and pubes is common. In the marsupials and monotremes a portion of the external oblique muscle ossifies to form marsupial bones.

The patella is first noted in the Reptilia, though not common to all. All mammals and birds have this bone excepting a few bats. In the marsupials it commonly remains in the cartilaginous stage. In birds the fibula is often absent or fuses with the tarsal bones, and no ankle joint remains. In the marsupials the enlarged upper end of the fibula may articulate with the femur. Consult any standard work on anatomy; Reynolds, ‘The Vertebrate Skeleton’ (1897); Dwight, Thomas, ‘Clinical Atlas’ (Philadelphia 1907); Fraser, J. S. S., ‘Anatomy of the Human Skeleton’ (1914). See ANATOMY; BONE; OSTEOLOGY; SKULL.

SKELTON, John, English poet: b. apparently in Norfolk, about 1460; d. London, 21 June 1529. He studied at both Oxford and Cambridge, and from both, as well as from the court, he received the laureateship. In 1498 he took holy orders, and subsequently was appointed to the benefice of Diss in Norfolk. In an epistle dedicated to him by Erasmus, that writer declared him to be the *lumen et decus* of British letters. In the pulpit he was remarkable for his buffooneries and according to Anthony à Wood was esteemed “fitter for the stage than for the pew or pulpit.” There were three objects at which he delighted to aim his satire — the mendicant friars, Lily the grammarian and Cardinal Wolsey. His attacks on Wolsey at length aroused the resentment of that prelate and an order being issued for his apprehension, he took refuge in the sanctuary at Westminster, where the abbot afforded him protection until his death, not long before the fall of Wolsey. His works comprise among others the drama or morality of ‘Magnyfycence’; a satire on Wolsey, entitled ‘Why come ye not to Courte?’; the ‘Tunnynge (what is the brewing) of Elynoure Rummynge,’ a humorous picture of low life, and the ‘Book of Phylyp Sparrow,’ an elegy on the sparrow belonging to the “goodly maid” Jane Scroope, which was killed by a cat. The last is the most poetical of his pieces. It is said that his own opinion,

> Though my ryme be ragged,
> Tatter'd and jagged,
> It hath in it some pyth.

is reasonably just. The best edition of his works is by the Rev. Alexander Dyce (1843).

SKENE, skĕn, **Alexander Johnson Chalmers,** American physician and pioneer gynecologist: b. Fyvie, Aberdeen, Scotland, 17 June 1837; d. High Mount, N. Y., 4 July 1900. He came to America in 1856, was graduated at the University of Michigan in 1861 and at the Long Island College Hospital in 1864. He was a surgeon in the United States army in 1863–64, and later was engaged in practice in Brooklyn. He was appointed adjunct professor at the Long Island College Hospital in 1864, professor of gynecology there in 1872 and from 1886 he was dean. He was consultant at many hospitals and dispensaries and was notable among the American pioneers in gynecology. He was author of many treatises and textbooks.

SKENE, William Forbes, Scottish historian and Celtic scholar: b. Inverie, Inverness-shire, 7 June 1809; d. Edinburgh, 29 Aug. 1892. He was educated at Saint Andrews and Edinburgh Universities. In 1832 he became a writer to the *Signet*, and was for some 40 years the head of a prominent legal firm. From an early age he devoted his leisure to archæological and historical research. His chief works include ‘The Highlanders of Scotland, their Origin, History and Antiquities’ (1837); ‘The Four Ancient Books of Wales’ (1868), and ‘Celtic Scotland, a History of Ancient Alban’ (1876–80). Besides the above he edited ‘The Dean of Lismore's Book, with Introduction and Notes’ (1861); ‘Ancient Gaelic Poetry’; ‘Chronicles of the Picts and Scots, and other Early Memorials of Scottish History’ (1867); and Fordun's ‘Chronicles of the Scottish Nation’ (1871). In 1881 he was appointed historiographer royal for Scotland.

SKERRETT, Joseph Salathiel, American naval officer: b. Chillicothe, Ohio, 18 Jan. 1833; d. Washington, D. C., 31 Dec. 1896. He was appointed a midshipman in the navy in 1848 and served with the African squadron engaged in the extermination of the slave trade and was on the *Saratoga* when she captured the *Nightingale,* the last of the American slavers, with 1,000 slaves on board. He was promoted lieutenant-commander in 1862 and as commander of the gunboat *Aroostock* of the Western Gulf squadron, successfully attacked the Confederate fortifications at the mouth of the Brazos River, Texas. He was made commander in 1867, and in command of the *Portsmouth* in 1873 averted the threatened revolution in Honolulu. While in charge of the *Richmond* of the Asiatic squadron in 1881–84 he settled the trouble in which the United States consul at Samoa had become involved. He was on duty at the Naval Asylum in Philadelphia in 1884–86, commander of the Pacific station in 1892–93 and in 1893 became commander of the Asiatic squadron.

SKERRYVORE, sker-ĭ-vōr', Scotland, a dangerous reef lying about 12 miles southwest from the Isle of Tyree on the west coast of Scotland, in the fairway of vessels making for the Clyde and Mersey. The reef was long a danger to navigation until the completion of the celebrated Skerryvore lighthouse in 1844. The tower designed and erected by Alan Stevenson is 137 feet 11 inches in height, 42 feet in diameter at base, decreasing to 16 feet at top. For 26 feet in height the tower is solid. Above the solid the interior is 12 feet in diameter, divided into nine stories, surmounted by a light-room and lantern. Operations were commenced on the rock in 1838 and the light was exhibited in February 1844; it has a range of 18 nautical miles. The apparatus is dioptric revolving, the light attaining its greatest brilliance once in a minute; the machinery which drives the apparatus is also employed to toll fog bells. The total cost of the work was $434,885.

SKETCH BOOK, The. ‘The Sketch Book of Geoffrey Crayon, Gent,’ the work by which Washington Irving is best known, was published at New York in seven numbers during 1819 and 1820. The collected edition brought out in 1820 in London contained two earlier essays — ‘Traits of Indian Character’ and ‘Philip of Pokanoket’ — which have been included in all subsequent editions. The entire collection was revised and given its final form in 1848. «I have preferred,» Irving later explained, «adopting the mode of sketches and short tales rather than long works, because I choose to take a line of writing peculiar to myself.» More explicitly, he wrote brief pieces to keep himself from the contagious and overwhelming influence of Scott. In a miscellany like ‘The Sketch Book’ Irving could, and did, attempt several varieties of manner. ‘The Wife,’ ‘The Broken Heart,’ ‘The Widow and Her Son,’ and ‘The Pride of the Village’ fell in with a lachrymose tendency of the day and were long popular but have since lost most of their power to move. ‘Rural Life in England,’ ‘The Country Church,’ ‘Rural Funerals,’ and ‘The Angler’ are based upon actual observation; while not without sentimentalism they have still a pleasant faded charm. The charm has not faded from such essays as ‘Westminster Abbey’ and ‘Stratford-on-Avon,’ clear, affectionate pictures of honorable places. But Irving is at his best as essayist when, his eye keenly on the object, he discards sentimentalism and speaks in his natural idiom — humor: this he does in ‘The Boar's Head Tavern, Eastcheap,’ ‘Little Britain,’ ‘John Bull,’ and above all in the dainty series recounting the Christmas ceremonies at Bracebridge Hall. About the whole book there is a delicate flavor of the past which has led some readers to think that past and present were confused in Irving's mind. The truth, however, is merely that his imagination was highly susceptible to history and tradition, and he was as naturally a maker of legends as a humorist. This is borne out by the tales in ‘The Sketch Book’: ‘The Spectre Bridegroom,’ a merry parody, even to its bungling plot, of the horrific narratives then lately brought from Germany; and the masterpieces of the volume, ‘Rip Van Winkle’ and ‘The Legend of Sleepy Hollow.’ The central incidents of ‘Rip’ and the ‘Legend’ Irving did not invent; one came from a German, one from an American, source. Yet the two stories are as firmly localized in the Hudson Valley as if they had been founded on indigenous folk legends. Both are ascribed to Diedrich Knickerbocker. Both are mellow and rich in style, kindly and chuckling in humor, happy in characterization, and picturesque in description; the plots move with the accomplished ease of perfect leisure, and the landscapes have the golden look of perpetual autumns. Easily the two best short stories in English for the first three decades of the 19th century, they still unquestionably stand, after a hundred years busily given to the development of the short story type, among its undimmed triumphs.

Carl Van Doren.

SKETCHLEY, skĕch'lĭ, **Arthur.** See Rose, George.

SKI, or **SKEE,** a wooden snow-shoe, or runner of wood, from five to 10 feet long, five inches wide and an inch or more thick at the middle, but thinner toward the ends, and curved up at the front; a ridge or more frequently a slight groove is made longitudinal of the under surface, to resist side slipping. The ski is popularly worn in Norway, Sweden, Lapland, Finland, etc., and has been adopted in other countries for sport. The fastening of the ski to the foot consists of a loop for the toe and a band which passes from this around the heel of the shoe, binding the ski and the foot as firmly as possible, which is necessary in order to steer well, while full freedom is allowed the heel to rise from the ski at every movement. When first putting on the ski, a balancing stick is necessary, and it is indispensable for some time; the most skilful runners need but a small stick. An ordinary ski runner can maintain a speed of eight to nine miles an hour for quite a length of time as his down hill travel is all coasting. The uphill work is zigzag. The longest race on skis, the distance being nearly 140 miles, was run in less than 22 hours, rests included. A race in Christiana won by a peasant in less than 5 hours covered 32 miles, laid over hilly ground including all kinds of difficulties calculated to test the competitors' skill. A Swiss soldier «skieur» made a record of 25 kilometers in 90 minutes in a rolling country, covering one elevation of 1,550 feet. Leaps of 75 feet are no longer unusual, and more than twice this distance has been recorded. For jumping, a hillside is selected with a large steep slope, and a short rise is built as the place for the leap. As the skiman attains this he stoops and adds his own jumping effort to the force which flings him on into space. He must land on his feet without falling to make a successful jump. The annual tournaments held in the principal cities of Sweden and

Norway are the great sporting events of the year, the great feature of the sport being the ability to take long flying leaps. These proved so popular that the sport spread to other countries, and has been common in the northern United States and Canada. There have been numerous ski tournaments in Montreal and Minnesota; and the number of runners in the United States has increased to an extent that has warranted the organization of a National Association. Consult Rickmers 'Ski-ing' (New York 1909); and Cauldfield, 'How to Ski' (New York 1914).

SKIASCOPE, an apparatus for making observations of the influence of the Röntgen rays on a fluorescent screen. A well-known form consists of a tapering light-tight box, provided at the narrow end with a closely-fitting open cap of black velvet or other soft dark-colored material into which the face will fit closely and exclude light, and at the other end is fixed the fluorescent screen. On looking through the instrument toward an excited Crookes tube placed near it the screen exhibits fluorescence where the Röntgen rays are not interfered with by objects sufficiently dense to obstruct their passage. When objects that are opaque to the Röntgen rays, such as glass, bones and most of the metals, are intervened a shadow of them appears on the screen. Thus if the human hand is placed between the tube and the screen the Röntgen rays will penetrate the flesh but be obstructed by the bones, producing a shadow picture of the bones of the hand.

SKID, one of a pair of logs or beams laid lengthwise as a support in rolling logs, barrels or the like. When a line of parallel logs is thus laid to form a roadway along which logs can be hauled, it is termed a skidway. To move logs on it is «skidding.»

SKIDDAW, skĭd'â, one of the highest mountains of England, in Cumberland, distinguished for its grand and romantic scenery, as well as for the lakes in its different hollows and near its base; height, 3,054 feet. It is three miles north of Keswick.

SKIFF, Frederick James Volney, museum director and exposition authority: b. Chicopee, Mass., 5 Nov. 1851. He engaged in newspaper work in the West and was manager of the Denver *Tribune*, 1881–85. In 1889 he was appointed commissioner of immigration and statistics for Colorado. Represented Colorado at the Inter-State Expositions of Chicago and Saint Louis, 1889–90. In 1890 President Harrison appointed him one of the national commissioners to the World's Columbian Exposition; subsequently resigned and was appointed chief of the Department of Mines and Mining and later became deputy director-general. At the close of the Chicago Fair he became director of Field Museum of Natural History, Chicago, which position he has since held. He organized the Jury System of the Nashville Exposition of 1897; was director-in-chief for the United States Commission at the Paris Exposition of 1900; was director of exhibits Saint Louis Exposition 1904. President Roosevelt appointed him commissioner-general for the United States to the Japanese Exposition of 1912. In 1911 he accepted position of director-in-chief of the Panama-Pacific Exposition at San Francisco, 1915.

SKILTON, James A., American lawyer and scientist: d. Brooklyn, N. Y., 4 March 1904. He is best known as the friend of Herbert Spencer, to whom he gave much practical aid, and spent thousands of dollars in the purchase and distribution of Spencer's publications. He was a close friend of Henry Ward Beecher, an active worker in Plymouth Church for 45 years and an able writer on economic conditions and the government of great cities.

SKIMMER, or SCISSORS-BILL, an American sea-bird (*Rhynchops nigra*), related to the gulls, and distinguished by the long, thin, knife-like bill. See SHEARWATER.

SKIMMIA, a Japanese name for genus of evergreen shrubs, of the *Rutaceæ*, native to India and Japan, with green branches, alternate, entire, coriaceous and pellucidly dotted leaves, crowded at the ends of the branches, and small four- to five-merous flowers, in much-branched white and odorless, terminal panicles. *S. japonica* and *S. fortunei* are dwarfed holly-like shrubs, not entirely hardy in the northern United States, but valuable for planting in warmer countries, especially in cities, as they are among the best smoke-enduring evergreens. They are also valued for winter gardens, and for Christmas decorations, since they are covered with bright red, berry-like fruits, which hang on during the winter, and contrast handsomely with the dark, shining leaves.

SKIMMINGTON (also SKIMMERTON), a word formerly used in England, in the phrase, «To ride skimmington,» or «To ride the skimmington,» a burlesque procession in ridicule of a man who allowed himself to be henpecked. The man rode behind the woman, with his face to the horse's tail.

SKIN-GRAFTING, the surgical procedure of covering over areas of the body denuded of skin with live skin freshly taken from another part of the patient's body or from another individual. It may be rendered imperative by the great extent of surfaces so denuded, or by disabling or disfiguring contraction. Reverdin's method consists in applying to the raw clean surface small points of superficial epithelium. From these centres a new skin is formed. Thirsch's method consists in covering the raw surface with strips of surface skin of variable length and width. These quickly adhere to the raw surface and if the operation is successful are taken into the epidermis of the patient. In this manner large surfaces as of burns and old sores have been healed over.

SKIN AND SKIN DISEASES. The skin is the group of organs which form the outer covering of the body. It may be regarded as an extensive, complex, uninterrupted membrane, actively functionating, and merging into the mucous membranes at the natural orifices of the body. Beneath it stands in the most intimate structural relationship to the underlying tissues; externally it is exposed to varied and innumerable contacts with the outer world. By reason of this unique position as the boundary of the living organism, the skin has important functions to perform, all of which are contributory to the well-being of the individual, while some are essential to his continued existence.

To the touch the skin in general is approximately smooth, soft, supple and movable upon the underlying tissues. In certain localities — those subject to special contacts, as the palms and soles — it is more dense and less pliable than elsewhere. Inspection discloses the presence of various surface markings in the form of minute pores and intersecting lines, furrows, and ridges. There is also seen an extensive but variable growth of hair, and at the end of the dorsal portions of the fingers and toes are the horny structures known as the nails. The pores represent the combined openings of the sebaceous glands and the hair-follicles, and as such give exit to the hair-shafts. The lines and furrows of the skin are primarily the product of its elasticity. They are fine, intermediate and coarse. The last type is best seen about the joints, or upon the palms, where by reason of great latitude of movement, the skin is often thrown into folds; the other types occur upon those parts less subject to wide range of motion. The ridges are best observed upon the palms and soles, appearing in curved and straight, more or less parallel formations, said to be characteristic in each individual. Hair is quite generally distributed over the body surface, though certain parts are free; the amount and quality vary greatly with the location. The nails, though unlike the skin in texture and appearance, are entirely derived from the dermal tissues.

Anatomy of the Skin.— Technically in description the term skin includes only the cellular and connective-tissue layers, with their blood-vessels and nerves. The highly differentiated structures which by derivation, function, and position are a part of the skin, as the sebaceous and sweat glands, hairs, hair-follicles, and nails, are termed appendages of the skin. From within outward the skin proper is made up of three layers: the subcutaneous tissue or hypoderm; the corium or true skin, called also the cutis or derma; and the epidermis, cuticle, or scarfskin. The hypoderm can scarcely be considered a distinct layer; it is more properly a connecting bond between the body tissues internally and the corium externally. It is loose in texture, and is composed of interlacing fibrils and bundles of connective tissue, more or less obliquely directed, within the wide meshes of which are deposited masses of fat. This fatty tissue in the hypoderm forms the panniculus adiposus, and to it is due the rounded contour of the well-nourished body. Its disappearance by absorption following prolonged illness, and in old age, produces angularity of feature and wrinkling of the skin. Besides blood-vessels, lymphatics, and nerves, this layer contains sweat-glands, deep hair-follicles, and special nerve-endings. The corium, cutis, or derma, is made up in general of a more or less dense network of fibrous and elastic tissue, carrying within it vessels, nerves, glands, hair, and hair-follicles. It is divided into two layers; the pars reticularis and the pars papillaris; but the dividing line between the two is not clear-cut. The pars reticularis is the layer in contact with the subcutaneous tissue. It is well described by its name — a reticulum of loose connective tissue. The pars papillaris is relatively much thinner, but more dense than the pars reticularis, and lies external to the latter. It derives its name from the fact that its outermost portion presents innumerable papilla-like projections, which interdigitate with corresponding downward prolongations from the innermost layer of the epidermis. The total number of papillæ upon the body surface is enormous; an estimation of approximately 64,000 to the square inch has been made. The curved and parallel ridges previously mentioned as seen upon the palms are due to an arrangement of papillæ in rows. Each papilla is provided with a vascular loop or a special nerve-ending; rarely both are present. The proportion of the vascular to the nervous variety is about four to one; hence it is that the especially sensitive areas of the skin contain the greater number of papillæ.

The epidermis or cuticle is the portion of the skin intervening between the corium and the external world. Though structurally in most intimate relation with the true skin, by derivation it is totally distinct from it, being developed from the epiblast of the embryo, whereas the corium springs from the mesoblast. As the epidermis is avascular, nourishment is provided by means of juice-spaces in the deeper portions. The lower cells are therefore soft and succulent, and the extent of the change necessary to transform them into the dry, horny, and flat cells of the skin surface is readily apparent.

For purposes of description the epidermis is divided from within outward into four layers, the stratum mucosum, the stratum granulosum, the stratum lucidum, and the stratum corneum. The stratum mucosum, called also the rete mucosum or Malpighii, the mucous or prickle layer, consists of several superimposed strata of cells, which fill in the interpapillary spaces of the corium, and present an undulating, plane surface to the layer next above. The cells in general are rich in protoplasm, have clearly defined nuclei, are columnar and polygonal in shape, becoming flattened as the surface is approached, and are provided with radiating, spine-like, protoplasmic processes or "prickles," which anastomose and interdigitate one with another. A viscid intercellular cement-substance is present, permeated by channels for the passage of nutritive fluids. The layer of cells in immediate contact with the corium has been aptly termed the stratum germinativum, since it is by multiplication of these that both physiologic exfoliation and pathologic loss of the epidermis are restored. The pigment which gives color to the skin is found in this layer, and nerve fibrils are abundantly present between and within the cells. The stratum granulosum is a narrow band of cells distinguished by the appearance of granules within the cell protoplasm. These are highly refractile, and are composed of keratohyalin, a substance believed by some to be the antecedent of keratin, the horny material in the cells of the skin surface. The stratum lucidum is also narrow, and is made up of more or less flattened cells, with faint nuclei and a homogeneous and lucid-appearing protoplasm. The granules of the preceding layer have totally disappeared, and instead a substance called eleidin is found diffused throughout the cell body. This is regarded by some as a solution of the keratohyalin in the cell protoplasm. Others consider it a totally distinct body and not related to the product keratin. The stratum corneum is the most superficial layer. It is relatively thick, and its component cells are flat, dry, horny, and resistant, from the presence of keratin. Nuclei are absent or very faintly outlined. By special treatment the remains of the "prickles" may be detected. A well-grounded assertion has been made that the succulent protoplasmic spicules of the rete, by desiccation and other change, give origin to the keratin of the corneum. Constant exfoliation of the superficial cells of the skin is in progress, the loss of substance being compensated by growth from below.

The vascular supply of the skin is abundant. The numerous arterial branches emerging from the deeper tissues divide and subdivide to form an intricate horizontal network of vessels in the subcutaneous tissue. A second plexus is formed by division of radicles from the first at about the level of the papillary bases. From these arterioles capillary loops extend into the papillæ. The distribution of veins and venules for the return of the blood is practically the same as that of the vessels for the arterial flow; the venous channels, however, are considerably larger. For the passage of lymph, juice-spaces and lymph-vessels exist. The former are mere excavations in the intercellular cement-substance, communicating with one another, and eventually emptying into lymphatic vessels. These latter are channels with definite endothelial walls; they appear first at the bases of the papillæ as blind terminals, and by anastomoses from dense plexuses in the corium and subcutaneous tissues. The vessels receive the lymph from the juice-spaces through openings between the vascular endothelia, and eventually discharge their contents into the veins. The lymph which nourishes the epidermis flows from the papillary apices, percolates between the cells of the rete, and returns by way of the interpapillary spaces.

The nerves of the skin are (sensory) medullated and (vegetative) non-medullated. The latter form a dense plexus immediately beneath the rete mucosum; thence fibrils ascend, penetrating as far as the granular layer, and terminating either within or between the cells of the rete. Special nerves of non-medullated variety, known as vaso-motor nerves, are distributed to the muscle-fibres of the vessel-walls. The medullated nerves are confined to the papillary and subcutaneous layers, and are peculiar in that they terminate in special end-organs. Three varieties of these are found in man: the corpuscles of Krause, the corpuscles of Meisner, and the Paccinian corpuscles. While these differ in minute structure, in general all may be described as round or oval bodies, made up of concentric layers of connective tissue, enclosing the blunt or coiled termination of a nerve which enters at one pole of the mass. The first two kinds are found within and beneath the papillæ, especially in sensitive parts, while the Paccinian corpuscles occur in the subcutaneous tissue throughout the body. Trophic nerves are present in the skin, they belong to the vegetative system and are non-medullated. Muscle-fibres of the smooth or unstriped variety are found in the corium of certain parts, especially the face. The principal muscular structures in the skin, however, are the arrectores pilorum. These are smooth muscle-bundles which arise from the lower portion of the walls of the hair-follicles and extend obliquely upward to be inserted into the pars papillaris of the corium. Contraction of these muscles produces erection of the hair, or on the glabrous skin the condition known as "goose flesh." The pigment of the skin resides in the lower cells of the rete mucosum. It appears as black granules of melanin within the cell protoplasm, chiefly about the nuclei. In the dark races the pigment is found in the superficial cells, in some cases even in the corneum. The tint of the skin is also influenced by vascularity. Many theories have been advanced as to the origin of the skin pigment; it seems most probable that it is derived from the coloring matter of the blood in the corium, and thence carried to the rete by wandering cells. Two kinds of glands exist in the skin; the sweat, or sudoriparous glands, and the sebaceous or oil glands. The sweat-glands are found in the hypoderm and lowermost portion of the corium. Each consists of a single long tubule, with a blind extremity, coiled many times upon itself to form a round or oval mass, from the upper part of which the excretory duct ascends. This is merely a straight portion of the tube slightly modified; it enters the rete opposite an interpapillary space, and after an irregular and spiral course through the epidermis opens upon the free surface of the skin, forming the sweat-pore. Besides the single layer of secretory cells, an investing membrane, unstriped muscle fibres and nerve filaments compose the tubule, and many blood-vessels are distributed in and about the coils. The duct has a lining of several layers of cells, and a more distinct investing membrane; in the rete these disappear, and through the corneum no definite lining exists. The sebaceous or oil glands are usually found in connection with the hair-follicles, but may occur where hair is absent, as on the lips. Their seat is the corium; each consists of one or several, sometimes many, pear-shaped lobules, lined with epithelium and invested with fibrous tissue. All the lobules open into a common gland-cavity, which in turn discharges into the upper portion of a hair-follicle. The product of the gland, called sebum, is formed by fatty degeneration of the epithelial cells within the lobules; its extrusion is favored by the contraction of the arrector pilorum, which compresses the gland against the hair root.

Hairs, though quite generally distributed, are absent on the palms, soles, the dorsum of the last phalanges of the fingers and toes, and the lips. They vary greatly in amount, quality, and distribution, these being influenced by age, sex, climate, racial and individual peculiarities. A separation of hairs into three classes may be made: long hairs, over two inches in length, found on the scalp, axillæ, pubes, and bearded portion of the face; bristle hairs, short and stiff, as those comprising the eyebrow and eyelashes; and downy hairs of lanugo, short, fine and soft, found on parts of the face, the trunk and the extremities. Each hair may be divided into two parts; the shaft, or portion projecting above the skin surface, and the roots, or part imbedded in the skin. The shaft is made up of the cuticle, a single layer of imbricated cells covering the exterior; the cortex or main body of the hair, composed of spindle-cells, massed into elongated bundles; and the medulla or pith, of irregular cells containing air-vesicles. The color of hair is due to the presence of granular and diffuse pigment in the cortical substance, and to air in the cortex and the medulla. The hair-root is seated within the hair-follicle; its extremity is expanded into the hair-bulb, which is invaginated by the hair-papillæ carrying a vascular supply. In the hair-root the cells comprising the layers mentioned are softer, and more nearly approach the character of the rete-cells, from which the hair is derived. The hair-follicle is the elongated pouch-like depression which receives the hair-root. It is usually obliquely set, and in detail of structure is rather complex. A better understanding of its formation may be had if it be remembered that the follicle is merely an invagination of the skin-layers; the outer portion, therefore, is made up of the derma, while the inner layers are furnished by the epidermis. Hence a dermic coat and an epidermic coat are distinguished. Each of these is further divided into layers; the dermic coat into three, namely an external, fibrous and vascular; a middle, fibrous, possibly muscular in part; and an internal, thin and hyalin. The epidermic coat has several layers, the nomenclature of which is not entirely fixed. These, too, are quite complex in structure and for practical purposes a division without description into the outer root-sheath, the inner root-sheath and the cuticle of the root-sheath will suffice. The first two are by some regarded as a part of the hair proper. These strata are derived entirely from the rete mucosum by differentiation; the corneum does not enter the follicle beyond the opening of the sebaceous gland.

The horny formations upon the distal portions of the dorsum of the fingers and toes are strangely unlike the general skin in appearance, yet they are derived directly from the cells of the rete mucosum. For description, the nail is divided into two parts: the nail-body, or uncovered portion, and the nail-root, or portion imbedded in the tissues. The entire nail rests upon the nail bed or couch. The part beneath the nail-root is known as the matrix. The depression into which the nail is set posteriorly and laterally is the nail-groove. The skin overlying the imbedded portions is the nail-fold and the adherent film extending onto the nail-body from the nail-fold is termed the nail-skin. The lunula, the white curved border seen at the base of the nail represents the distal border of the matrix. The tissues beneath the nail are dense and vascular, but are poorly supplied with nerves. The papillæ are numerous and their arrangement in rows produces the longitudinal striæ seen on the surface of the nail. The hypoderm is devoid of fat and is closely adherent to the periosteum of the phalanx, thus presenting a solid foundation upon which the nail may rest. Growth takes place from the matrix; although the rete mucosum underlies the entire nail, only the rete-cells of the matrix undergo the transformation into horny nail-substance.

Physiology of the Skin.— The complex histological structure of the skin and its appendages is necessitated by physiological requirements. As the living encasement of the body, its functions are necessarily related to external and internal factors. Thus it protects the organism from harmful influences from without; it provides a sense-organ that is necessary to a correct interpretation of the external world; it contributes largely to the regulation and conservation of body heat; and it removes from the organism quantities of waste and harmful material. All the dermal structures participate in the protective function of the skin. The connective and adipose tissue of the hypoderm; the dense fibrous and elastic meshwork of the corium; and the horny cells of the epidermis, rendered unctuous by glandular secretion, are together admirably adapted to guard the deeper structures from injury by mechanical violence, to prevent undue loss of heat and fluids from within, and to resist the penetrating or destructive action of fluids from without. The hair in man, especially on certain parts, is protective from violence and thermal change, but not to the same degree as in animals; in them it is obvious that the fur, composed of densely set hairy filaments distributed over the entire body, must act as a potent agent in turning aside harmful encroachments from the exterior, and in conserving body heat. The cutaneous nerves contribute to protection in that the sensibility of the skin may warn the individual of possible dangerous contacts, often in time to prevent harm.

Sensation in the skin is provided for by the presence in abundance of nervous filaments and special nerve end-organs. Although many kinds of sensations are perceived through the skin, the exact part performed by each of the several varieties of nerve terminations is not fully known as yet. By means of the tactile sense the individual is able to judge the shape of an object in contact and the portion of the skin touched by it: he can appreciate its weight and recognize whether it is hot or cold. These varieties of tactile sense — locality sense, pressure sense and temperature sense — are not resident in one and the same variety of nerve or nerve-termination. Pain has been considered an overstimulation of sensory fibres; experimentation, however, seems to show that special nerves are concerned when pain is felt. The skin through perception of pressure and tension, is in part responsible for muscular sense, by means of which the individual is cognizant, without the aid of the eye, of the position of his body with reference to surroundings. Special sensations, as itching, burning, tickling, creeping, etc., are perceived through the skin; the nerves concerned in their reception and conduction are known chiefly as belonging to the vegetative system.

The skin plays an important rôle in the regulation of bodily temperature. The action of excessive heat from within or without, upon the vasomotor nerves distributed to the blood-vessels of the skin, causes the latter to dilate. An increased amount of blood is thus brought to the skin, where it is cooled by conduction and radiation and also by evaporation. The latter effect results from the increase of moisture on the skin, following an acceleration of sweat-gland secretion, due to augmented blood-supply.

On the other hand, cold, acting upon the vasomotors, leads to contraction of the vessels; a diminished amount of blood enters the skin; evaporation is reduced by the checking of sweat secretion; and bodily heat is conserved.

The secretory and excretory functions of the skin are carried on by the sebaceous and sweat glands. The product of the former, a fatty, unctuous material, cannot be strictly regarded as a secretion. Its purpose rather is to anoint the hair and skin, thus keeping the latter soft and preventing heat loss by evaporation, and maceration of the epidermis by moisture. The sweat, however, is a true excretion and as organs for the removal of waste products the sweat-glands are most important. Various estimations have been made of the amount of sweat produced in 24 hours; the average is probably about one and one-half pounds. This can be greatly increased by muscular activity, by high external temperature and by the use of certain drugs; it is obvious, therefore, that considerable material can be removed from the body through the skin, a fact of great importance in the treatment of certain diseases. The sweat itself is about 99 per cent water; the remaining 1 per cent represents a number of complex fatty bodies and mineral salts. It may be alkaline or acid in reaction; acidity is in part due to admixture of fatty acids from the sebaceous secretion. It has been claimed that the sweat-glands produce no fat, but it is generally accepted now that this is not true, since the secretion in the palm, a part devoid of sebaceous glands, unquestionably contains fatty products.

The skin possesses a respiratory function, but it is comparatively insignificant. Carbonic acid gas is given off and oxygen absorbed, the relative amounts of each as compared with those from the lungs, being 1-220 of the former, and 1-135 of the latter. The interchange probably takes place through the sweat-pores. The skin also exhibits a certain degree of absorptive power. This is but slight in the undamaged skin. If the horny layer be removed, or if the substance be forced into the glandular ducts, absorption may take place readily, especially of certain substances.

Diseases of the Skin.—Abnormal or diseased conditions of the skin, as of other organs, are recognized by manifestations called symptoms. These are all referable to one of two categories: subjective symptoms and objective symptoms. By the former is meant those which are appreciated only by the patient himself; by the latter, those which may be detected by the examining physician. Subjective symptoms in purely cutaneous diseases are, in many instances, wanting; when present they are manifested in some form of abnormal sensation, as burning, prickling, tingling, smarting, creeping or itching; in diminished sensibility or anæsthesia; in increased sensibility or hyperæsthesia; or in pain, which latter may be burning, shooting, boring or aching. Of all subjective symptoms, itching or pruritus is most common; it is constantly present in many conditions, though often in varying degree.

Objective symptoms are vastly more important. To the person afflicted they often seem the visible manifestations of disfiguring, repulsive disease, and their appearance is therefore dreaded; to the dermatologist they stand for facts and principles which, when aggregated, constitute the major portion of his special knowledge, and which he must know and understand most thoroughly if he shall hope to be proficient. Any alteration from the normal in the texture and appearance of the skin is termed a lesion. Lesions are variable in appearance, character and manner of evolution, which fact is the basis of their subdivision into two general classes: elementary or primary lesions; and consecutive or secondary lesions. These terms are self-explanatory; the former are lesions which at their inception present a certain type; the latter are those which are produced by progressive alteration from a previously existing type. The classification is not entirely accurate, however, for under certain conditions a lesion of a primary type may appear as secondary. Briefly described, the objective cutaneous characters which are considered primary, eight in number, are: (1) Macules (spots or stains), circumscribed alterations in the color of the skin, without elevation or depression of the surface. They are variable in size, shape, color, duration and as to cause of the dyschromia. A familiar example is the "freckle." (2) Papules (pimples), small, usually superficial, pinhead to pea-sized, circumscribed, solid elevations of the skin. These, too, differ in size, shape, color, duration and cause. The "pimples" or papules of acne in young persons, illustrate this type of lesions. (3) Tubercles (nodules), solid, fairly circumscribed, pea-sized, deep-seated elevations, usually persistent in character. These are in reality large papules, or more properly, intermediate lesions between the papule and the tumor, to be next described. In severe acne tubercles are sometimes found. (4) Tumors, soft or firm, more or less circumscribed elevations of the skin, varying in size and shape, and seated deeply, in the corium and subcutaneous tissues. As the papule merges into the tubercle, so the tubercle passes over into the tumor; thus at one extremity of the series stands the pinhead-sized papule, at the other, the egg-sized or larger tumor. (5) Wheals, circumscribed, reddish-white, œdematous elevations of variable size and shape, usually evanescent in character. This form of lesion occurs typically in the condition known as urticaria (q.v.) or nettle-rash. It is angioneurotic in origin and is always accompanied with subjective symptoms, especially itching. (6) Vesicles (little blisters), circumscribed elevations of the horny layer of the epidermis, pin-point to pea-sized, with limpid, lactescent or sanguinolent contents. This form of lesion may at times be secondary, since it can develop on a previously existing papule, as illustrated in smallpox. (7) Pustules, pin-point to filbert-sized, circumscribed cutaneous abscesses, having an epidermal roof-wall. The skin surrounding the base usually shows an inflammatory areola. They are developed very frequently from vesicles, less often from papules. It is, in fact, somewhat questionable to class the pustule as a primary lesion. They are seen commonly in acne. (8) Blebs (large blisters), irregularly shaped elevations of the epidermis, varying in size from a pea to a goose egg, containing clear or opaque fluid. This lesion is well illustrated by the blister following a severe burn.

The secondary or consecutive lesions of the skin, six in number, are: (1) Excoriations (abrasions, scratch-marks), variously sized and shaped areas, representing loss of superficial cutaneous tissue, the result of mechanical violence. (2) Fissures, linear cracks or wounds of variable size, involving the epidermis, or the epidermis and corium, due to disease or external injury. These are seen not infrequently in the palms or about the angles of the mouth, when from any cause the parts have become inelastic. (3) Scales, dry, laminated, masses of epidermis which have separated from the underlying tissue as the result of some morbid process. They may lie in masses upon the skin, or be constantly exfoliated from the surface. Variations occur in color, consistency and form. (4) Crusts (scabs), dried, effete masses of exudation, mixed with epithelial debris, varying in size, shape and color. (5) Ulcers, variously sized and shaped losses of cutaneous substance, the result of preceding disease. In this form of lesion, differences are found in size, outline, depth, condition of floor, margins, etc. A familiar example is the leg ulcer in old people. (6) Scars, new connective-tissue formations replacing loss of substance in the corium or deeper tissues.

Besides recognizing the presence and detailed appearance of the lesions upon the skin, the diagnostician must also note their distribution upon the body surface, their general arrangement and their configuration when grouped together. All these considerations help to elucidate the condition present.

In the etiology of skin diseases many factors are operative. For convenience of description these may be classed as internal causes and external causes. Among internal causes, heredity may be mentioned first. While not many cutaneous diseases are inherited, the predisposition to them may undoubtedly be passed on to the child. This predisposition probably is due to some form of tissue vulnerability to influences which otherwise might not suffice to produce disease. Disorders of internal organs are frequently effective. Their exact relation to the skin disorder may not be entirely clear; but the joint association of internal and cutaneous disease in many instances is too regular and frequent to be a mere coincidence. Thus, gastro-intestinal derangements may produce erythema, eczema or urticaria; whether these are due to the intestinal disorder or both due to a more primary emotional disturbance is still an open problem; kidney disease may cause an eczema or pruritus; diabetes is not infrequently accompanied with boils, carbuncles, gangrene, dermatitis, urticaria or pruritus. Syphilis is attended with many forms of eruption; gout is frequently associated with eczema or psoriasis, and rheumatism with erythema and purpura. Asthma, eczema and urticaria are often found together. Lastly, emotional derangements may produce an array of functional disturbances in the skin and through reflex action on the vasomotor nerves may be the determining factor in the development of cutaneous lesions. The sexual system unquestionably exerts an influence on skin diseases. The prevalence of acne in the young, following puberty, is well known, and various cutaneous derangements are associated with physiological crises and pelvic disorders in women. Food may produce skin eruptions. Urticaria is not uncommon after ingestion of shell-fish, cheese or strawberries and the list of skin-irritating articles could be greatly extended. Eczema, acne and inflammatory conditions are greatly influenced by quantity and kind of food taken. Alcohol in inflammatory lesions is especially harmful.

Any of the many types of skin eruptions may develop following the use of certain drugs, the list of which is very extensive. Among those in most common use which may disturb the near tissues and hence the skin, are quinine, belladonna, morphine, arsenic, potassium bromide and iodide.

Climate may be considered an external factor. Warmth and moisture found in tropical and subtropical countries are especially favorable to the growth of certain parasites in the skin. Cold and moisture tend to induce eczematous conditions. Certain diseases are distinctly prevalent in certain countries, but the fact is not always due to climatic influence alone. The seasons differ also in their effect. Winter aggravates pruritus, eczema and psoriasis; summer improves them. Light, heat and cold are capable of producing inflammatory conditions. On the other hand, light is distinctly ameliorative in certain diseases, as psoriasis. Clothing when improper in amount, harsh of quality, poorly fitting, or uncleanly, can give rise to inflammation of the skin. Irritants of various sorts, whether mechanical, chemical or medicinal, can likewise awaken inflammation. Scratching and other traumatism are frequent causes of hyperæmia and dermatitis. Parasites, both vegetable and animal, are the most important of all external causes. A very large number of cutaneous diseases are traceable to them. Among the more common diseases produced by vegetable organisms are boils, carbuncles, various pus infections and the different forms of ringworm; by animal parasites, scabies and dermatitis from pediculi.

The number of cutaneous disorders under classification is about 170, but this does not include all tropical diseases. Of this seemingly large number, many are rare, others are seen but seldom, while a few are very common. Dermatologists have not agreed upon a uniform classification of skin diseases; their differences, however, largely concern minor distinctions. The following general classes are usually given as a basis for further subdivision: (1) hyperæmias; (2) inflammations; (3) hemorrhages; (4) hypertrophies; (5) atrophies; (6) new growths; (7) neuroses; (8) diseases of the appendages; (9) parasitic affections. By some authorities diseases of the appendages are considered among the other classes, as inflammations, hypertrophies, etc. The difference in the classification, however, is not essential, being rather one of convenience.

Bibliography.— For further discussion of the subject the following authorities, among others, may be consulted: Hartzel, 'Diseases of the Skin' (Philadelphia 1917); Ormsby, 'Diseases of the Skin' (ib. 1915); Pusey, 'Principles and Practice of Dermatology' (New York 1917); Shamberg, 'Diseases of the Skin and the Eruptive Fevers' (Philadelphia 1915); Stelwagen, 'Diseases of the Skin' (ib. 1916); Sutton, 'Diseases of the Skin' (Saint Louis 1917).

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SKINK, a genus (*Scincus*) of lizards of the cosmopolitan family *Scincidæ*, characterized by a conical head, with well-developed eyelids, and covered with symmetrical shields. The body is protected by bony plates underlying the scales. No thigh pores exist and in some genera the limbs may be hidden beneath the skin. In the genus *Scincus* itself the scales are of thin and smooth texture and the tail is rounded and tapering and is unprovided with spines. The body is somewhat spindle-shaped and is flat below. Five toes exist on each foot and the toes are of flattened shape and fringed on the sides. The palate is grooved longitudinally and is provided with teeth. The common skink (*Scincus officinalis*) occurs in North Africa and in India. It inhabits sandy places and when alarmed burrows swiftly beneath the sand. Its specific name is derived from the fact that formerly it was thought to possess valuable medicinal properties and among savage tribes it is regarded as an antidote to poison. In classic ages its virtues were much reputed and the head and feet of these lizards were imported to Rome in large quantities preserved in white wine. Its color is a variable reddish, marked above with cross bands of darker hue, while below it is of a white color, tinged with silvery lustre. The average length is from six to seven inches. The family is represented in the United States by several genera, of which *Eumeces* is the most prominent and is represented by several well-known species. Consult Holbrook, ‘North American Herpetology’ (Philadelphia 1848); Cope, ‘Crocodilians, Lizards and Snakes’ (Washington 1900); Gadow, ‘Amphibia and Reptiles’ (New York 1901).

SKINNER, skĭn'ẽr, **Aaron Nichols,** American astronomer: b. Boston, Mass., 10 Aug. 1845. He was educated at Beloit College, Wis., and at the University of Chicago, was assistant at the Dearborn Observatory, Chicago, in 1867–70, and assistant astronomer at the United States Naval Observatory in 1870–98. Since 1898 he has been professor of mathematics in the United States navy. He was retired from active service in 1907 with the rank of commander; he determined the position of 8,824 stars in the zone declination — 14° to — 18° as a contribution to the great star catalogue of the Astronomische Gesellschaft from declination — 23° to + 80° which was published as «Washington Zone Observations» and also as a «Zone Catalogue» conducted the expedition of the Naval Observatory to Sumatra to observe the total solar eclipse of 17 May 1901.

SKINNER, Charles Rufus, American legislator and educator: b. New York, 4 Aug. 1844. He was educated at Clinton Liberal Institute, and in 1870–74 he was manager and city editor of the *Daily Times*, Watertown, N. Y. He served in the New York assembly in 1877–81, and in Congress in 1881–85. He was New York State deputy superintendent of public instruction in 1886–92; and superintendent in 1895–1904. He was president of the National Education Association in 1897. In 1906–11 he was assistant appraiser of the port of New York. Author of ‘New York Question Book’ (1890); ‘Manual of Patriotism for the Schools’ (1900); ‘The Bright Side’ (1909), etc.

SKINNER, John, Scottish song writer: b. Balfour, Aberdeenshire, 3 Oct. 1721; d. Aberdeen, 16 June 1807. He was educated at Marischal College, Aberdeen; taught school for a time; took orders in 1742 in the Scottish Episcopal Church and settled at Longside, Aberdeenshire. He suffered during the period of persecution of Jacobite ministers after 1745–46 and in 1753 spent six months in prison for preaching in his own house. He is remembered for his songs, which placed him, in the estimation of Burns, as one of the foremost of Scottish song writers. Among these are ‘Tullochgorum’; ‘Ewie wi the Crookit Horn’; ‘John o' Badenyon’; ‘The Marquis of Huntly's Reel’; ‘Lizzie Liberty’; and ‘The Old Man's Song.’ His prose included ‘A Preservative against Presbytery’ (1746); ‘Dissertation on Job's Prophecy’ (1757); ‘Ecclesiastical History of Scotland’ (1788); His ‘Songs and Poems’ edited by Reid appeared in 1859.

SKINNER, Otis, American actor: b. Cambridge, Mass., 1858. He made his début Nov. 1877 as Jim in ‘Woodleigh’ at the Philadelphia Museum; New York début at Niblo's Theatre 1879. Assumed important roles with Lawrence Barrett, Augustin Daly and Madame Modjeska. After 1902 he was prominent as a star in plays of varied character under his own management and in conjunction with Charles Frohman.

SKINNER, William, American manufacturer: b. London, England, 1824; d. Holyoke, Mass., 28 Feb. 1902. He came to the United States in 1845 and settled in Northampton, Mass., where he engaged in the silk business. He became a partner in a silk manufacturing firm in 1848 and in 1851 established a business at Williamsburg, Mass. His factories being destroyed by the Mill River flood in 1874, he rebuilt them in the same year at Holyoke. He was actively engaged in philanthropic work, was a generous benefactor of Vassar, Smith and Holyoke colleges, built a gymnasium for Dwight L. Moody's school in Northfield, Mass., was president of the local city hospital and also of the Manufacturers' Association of Holyoke.

SKINNERS, bands of marauders, adherents to the American cause who infested what was considered neutral ground along the Hudson River in New York State, during the American War of the Revolution. The Skinners carried on a vigorous guerrilla warfare, being opposed by the Cow-boys, as the marauding adherents to the British cause were called. In some instances the Skinners did serviceable work for the American army, harassing small detachments of British soldiery, scouting and foraging parties, and acting as scouts for the Americans when occasion demanded. It was a party of three Skinners who intercepted André (q.v.) on his way back to New York, after receiving treasonous papers from Benedict Arnold (q.v.) at West Point. This was the chief service performed by the Skinners, who, like the Cowboys, operated principally in Westchester County and were not particularly scrupulous as to the party to which their victims belonged.

SKIPPER, a butterfly of the family *Hesperidæ*. The body is short and thick, head large, eyes prominent, antennæ short, with the knob curved like a hook or bent to one side, legs six, and the four hindmost shanks armed with two pairs of spurs. Skippers are generally rich brown, marked with yellow spots. The species are quite numerous, and expand from one and one-half to two and one-half inches. They owe their name to their jerky flight. The cheese-mite has also been termed skipper.

SKIRMISHERS are soldiers acting in loose array in front and on the sides of an army, in fighting carried on in an open country. It is the duty of the skirmishers to cover the line of advance of an army and to guard its flanks, so as to protect against surprise by the enemy. The skirmishers usually operate considerably in advance of the main body, from a mile to five miles, advancing in files of two men, front and rear, with a distance of about six paces between them. Skirmishers fire independently and at their own discretion and in modern warfare do not adhere strictly to the rules of the tactics, either as to their disposition or as to alternating between the files, in firing. Skirmishers were frequently used in the United States Civil War to draw on a battle or to cover the movement of the main body in their rear. When attacked by cavalry in open ground the skirmishers are supposed to close up ranks, forming what are known as rally squares. The manual of infantry tactics provides that every company of skirmishers shall have a small reserve, whose duty it is to fill vacant places and furnish the line with cartridges, and to relieve the fatigued. In trench fighting the strategy is quite different.

SKIRRET, a hardy perennial umbelliferous plant (*Sium sisarum*) about four feet high, with pinnate leaves and tiny white flowers in compound umbels. It is indigenous to Asia, and has been cultivated in rich, moist soil, for its edible, fleshy tubers, which are about as thick as a finger and grow in clusters, united at the base of the stem, and are long, cylindrical, and somewhat jointed. They have a sweetish taste, resembling parsnips, are somewhat floury, and are quite tender, except for a woody core, which must be removed before cooking. It is a winter vegetable, boiled and served like salsify, but is of minor importance at present.

SKITSUISH. See Salishan Indians.

SKITTLES, a favorite game in England much resembling the American game of Bowls (q.v.). It is played in a covered skittle-alley, usually indoors. From four to nine skittles or large wooden pins about a foot high with flat bottoms are set upright at one end of the alley a foot apart. They are arranged in a square, and one angle of this square is turned toward the player, or thrower, who stands at the other end of the alley, 21 feet away. The thrower uses a large wooden ball, about a foot in diameter, and which is not always round, which he throws along the floor of the alley with sufficient force to bowl over the pins at the other end; the thrower is allowed to advance but one step in the act of throwing. The object of the game is to knock down all or as many of the skittles as possible, each throw counting so many points, and the one who makes the greatest number of points in a given number of throws wins the game. The game of skittles was introduced into England under the name of Kails in the 14th century, having been brought over from the French. It is still popular and has developed in some places under the name of nine-pins, from the number of skittles used. In chess play, skittles is a rapidly played game, without effort at analysis of position.

SKLALLAM. See Salishan Indians.

SKOBELEFF, skŏ'bĕ-lyĕf, **Mikhail Dimitrievich**, Russian general: b. near Moscow, 29 Sept. 1843; d. Moscow, 7 July 1882. He entered the army and served in Poland in the suppression of the insurrection of 1863–64; and later in the campaigns in the Caucasus and in Central Asia. In 1873 he was attached as colonel to General Kaufmann's staff when the city of Khiva was taken, and in 1875 commanded the expedition against Khokand. This province being annexed in 1876 with its name changed to Ferghana, Skobeleff was appointed military governor; but at the outbreak of the Turkish war he hastened to the front, crossing the Danube on horseback. He held no commission until the second attack on Plevna in 1877 when he led three regiments, but was forced to sacrifice the advantage he had gained for lack of support. Being appointed lieutenant-general, he commanded the famous 16th division, with whom he turned back the left flank of the Turkish army, capturing 36,000 men, at the passage of the Balkans at Senova after Mirsky and Raditsky had failed. He led the advance upon Adrianople in 1878. His last military exploit was as commander of the expedition against the Tekke-Turkomans in 1880–81 and the conquest of Gök-Tepe on 12 January. He was promoted to the rank of general after the campaign.

SKODA GUN. See Ordnance.

SKOKOMISH. See Salishan Indians.

SKOPTZI, or **SKOPTSY**, a religious sect founded in Russia in the latter part of the 18th century by Kondratiy Seliwanoff. His followers practise castration in the belief that it will purify their souls and render them fit to enter heaven. Since 1869, when their practices were discovered by the Russian government, attempts have been made to suppress the sect by penal measures, but it is still believed to include a number of influential persons in its following. See also Religious Sects.

SKOWHEGAN, skow-hē'gan, Me., town, county-seat of Somerset County, on the Kennebec River, and on a branch of the Main Central Railroad, 33 miles north of Augusta. The first settlement in this vicinity was made in 1792; Skowhegan was at first a part of the town of Canaan, but was separately incorporated in 1823 under the name of Milburn; in 1836 it was given its present name, which is the ancient Indian name for the place. In 1856 the village of Skowhegan was incorporated. The town of Bloomfield was annexed in 1861. The Kennebec here has a perpendicular fall of 30 feet, and this furnishes excellent water power. The town has an area of 50 square miles and has a fine public park, hospital and courthouse. The industries include lumber, pulp, flour and woolen mills, shoe factories, and manufactories of scythes, axes, etc., and oil-cloth. There are several banks and newspapers. The town has a high school, and a public library (founded 1867). Pop. 5,000.

SKRINE, John Huntley, English clergyman and author: b. Somerset, England, 4 April 1848. He was educated at Oxford, ordained a priest in the Church of England in 1874, and in 1873–87 was assistant master at Uppingham. He was warden of Trinity College, Glenalmond, in 1888–1902 and in 1897 he was appointed canon of Perth Cathedral. He has published 'Margaret of Anjou' (1870); 'Under Two Queens,' lyrics (1884); 'A Memory of Edward Thring' (1890); 'The Queen's Highway,' lyrics of the war (1900); 'Pastor Agnorum, A Schoolmaster's After-thoughts' (1901); 'The Mountain Mother,' sermons (1902), etc.

SKUA, or JÆGERS, a large gull of the genera *Stercorarius* and *Megalestris*, and especially of the latter, the former being more often called "jæger." They are usually classed as a sub-family of *Laridæ* (q.v.). They are predatory birds, rarely fishing for themselves, and generally pursue smaller gulls and terns, and compel them to drop or disgorge their prey. Only one species of true skua (*Megalestris skua*) enters the North American fauna and this is rare. The related jægers are remarkable in the possession of a cered bill and a pair of elongated middle tail feathers, though the latter character is less pronounced than in the true jægers. It is a large, robust bird, especially when adult, and is remarkable for its vigorous and varied flight and piratical habits. It breeds in the far north, making a flimsy nest on the ground and lays two or three deeply blotched eggs. This species is more common on northern European coasts and three species of jægers are also common to the two continents and range even much more widely. They are the pomarine jæger (*Stercorarius pomarinus*), 21 inches long, dusky and mottled above, brownish-white below; the Arctic or parasitic jæger (*S. parasiticus*), about 20 inches long, occurring under two different plumages, one entirely sooty, the other with white under parts, and *S. longicaudus*, the longtailed jæger, about 14 inches long, upper part of head black, upper surface brownish-gray, under surface white. The middle tail-feathers in this species project 10 inches, and the bird is called "marlinspike" by sailors. Consult Selous 'Bird Watching' (London 1900).

SKULL, the skeleton of the head; the bony or cartilaginous framework of the head in vertebrates; a superior expansion of the vertebral column. Its shape differs in various animals. In man it is somewhat ovoid, the larger portion being at the top (the dome); and the whole is composed of flat and irregular bones — eight bones enclosing the cranial cavity and 14 forming the face. The skull rests and nods upon the first vertebra (atlas). It also rests upon a tooth-like process (odontoid process) of the axis, or second bone of the spinal column, which projects upwards through the atlas and forms a pivot or swivel, upon which the head rotates, the atlas also turning with it. The preponderance of the cranial portion of the skull over the face portion is most pronounced in man, because of the higher development of the brain. The cranial portion (cranium) is composed of the occipital, frontal, sphenoid and ethmoid bones, and the two parietal and temporal bones. These bones are united either by sutures (dovetail joints) or beveled edges. The upper bones of the skull of a baby do not usually unite until months after birth, their condition allowing the brain to grow. The dovetail joints later in life fasten these bones together very firmly. This jointure, together with the strong buttresses in the temporal bones and the tie-beam function of the sphenoid, adapts an adult for carrying considerable weight upon the head without injury. If the upper cranial bones of a baby are united at birth or soon after, the child is usually an imbecile or idiot. The tissue of the flat bones of the skull is arranged in layers; the outer one was likened by the ancients to wood, the middle one to leather, and the inner one to glass. The cranial cavity contains the brain and proximal portions of the cranial nerves. See BRAIN; CRANIAL NERVES.

The principal opening of the skull is the foramen magnum for the transmission of the beginning of the spinal cord, the spinal accessory nerves, and the vertebral arteries. Other openings to the orbits, the interior of the temporal bones, etc., transmit the optic, auditory, and other nerves, as well as blood-vessels, and are so arranged that these nerves and vessels are not easily injured.

The bones of the face are the inferior maxillary, and the vomer, the two nasal, superior maxillary, lacrimal, malar, palate, and inferior turbinated. The inferior maxillary, or lower jaw, forms the chin (a distinctive feature of man), moves in mastication and speech, and is joined to the temporal bone by a ball-and-socket joint. The lacrimal bones are small bones forming part of the inner wall of the orbit, one of the principal openings in the face. The malar bones are the cheek-bones. The palate-bones assist in the formation of the outer wall of the nose, the roof of the mouth, and the floor of the orbit. The nasal bones form the bridge of the nose; the vomer forms part of the septum of the nose, separating one nasal cavity from the other. The superior maxillary bones (maxilla, the jawbone) form the upper jaw and a large part of the roof of the mouth, the outer wall of the nasal fossæ, and the floor of the orbit. The inferior turbinated bones extend horizontally along the outer wall of the nasal fossæ. The principal external openings of the skull in the face portion are the orbits, the mouth, and the nasal opening; in the cranial portion, the foramen magnum, and the external auditory canal. See ANATOMY; HEAD; MEDULLA OBLONGATA; SPINE; SPINAL CORD.

SKULL-CAP, any one of the labiate genus *Scutellaria*, bitter herbs, having square stems, simple, opposite leaves, and blue or violet flowers, in terminal or axillary racemes. The flowers have exserted ascending corollas, curved, with arched upper, and spreading lower lips. The calyx is campanulate, gibbous, and two-lipped, the upper one with a crested protuberance on top, that causes it, when in fruit, to very much resemble an ancient helmet, with the visor down, and to which the common name obviously refers. This skull-cap covers four nutlets, which are ejected by the upspringing of the pedicel, if bent down by an animal, for instance; and it is said that the visor directs these seeds on to the animal's coat, when they escape from between the lips. However, the lid soon falls off. Several species are cultivated, as the Siberian (*S. baicalensis*), producing during the summer many dark-blue flowers an inch long; and the whole genus is one of the handsomest of the many American mints, excepting (*S. galericulata*), which is not showy. The madwort (*S. lateriflora*) is a common slender herb in wet places, with ovate leaves and violet flowers, and was at one time supposed to be a cure for hydrophobia.

SKUNK, a representative of several genera of small carnivorous mammals of the weasel family (*Mystelidæ*), of which they, with the badgers, constitute the sub-family *Melinæ*, characterized by having elongated toes with blunt non-retractile claws and no webs. The true skunks are notorious for the large size of the anal glands, and the offensive odor of their secretion. They are always black, marked by variously arranged and sharply contrasting bands and spots of white, and are exclusively American. Three genera are recognized. *Mephitis* includes the common typical skunks of relatively large size, with the skull arched above and the face short and truncated. There are 34 teeth with the following formula: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{1}{2}$. The body is elongated, and usually much arched; the tail long and thickly covered with long, fine hair; the head small, with thick, blunt snout; the legs short, and the paws comparatively large, with five incompletely divided toes. The power, characteristic in some degree of all the *Mustelidæ*, of forcibly discharging the fetid secretion of the anal glands is enormously developed. Ten species have been differentiated in North America ranging throughout the continent, but as they differ little in habit, the common skunk (*M. mephitica*) may be taken as typical of the whole genus. This species, as now limited, is confined to the Eastern States, where it is exceedingly common, particularly in the farming districts of New England. It is about the size of a cat and has fur of a glossy black; on the forehead is a patch of white diverging into two lines which extend the whole length of the back and meet again in the beautiful bushy tail. The tip of the tail is also white, and, as it is usually carried erect, the white is regarded by some naturalists as a "warning color." Thus Belt writes: "The skunk goes leisurely along, holding up his white tail as a danger flag for none to come within range of its nauseous artillery." It chiefly frequents high-lying, bushy, or rocky districts and the banks of the rivers, usually remaining concealed in its burrow by day, but emerging at dusk in search of the worms, insects, birds, small mammals, and their young and the eggs of ground birds which form its food. At times it becomes quite destructive to poultry, but offsets this by clearing out houses of rats and mice.

Its movements are slow and leisurely. It never attempts to run away if pursued, for, feeble and defenseless as it looks, it is most efficiently protected by the possession of a nauseous fluid, the discharge of which neither man nor beast will wittingly provoke. When attacked the skunk turns its back, erects its tail, and, by means of a muscular contraction, ejects the contents of its anal pouches from the protruding orifices of a pair of ducts with a force that carries them to a distance of 10 or 15 feet. So penetrating is the evil ordor of this fluid that it may sometimes be perceptible a mile off, and so persistent is it that clothes defiled by it can rarely be entirely purified. The fluid will excite severe inflammation of the eyes, and cases are cited of Indians who have thus lost their eyesight. Few carnivorous animals care to attack the skunk, and this immunity results in a life of comparative ease, with a loss of agility and an assumption of corpulency in striking contrast to the slender and active weasels. The skunk is hunted for its fur, which is in considerable demand. During the fall and winter skunk-hunting is an industry of considerable importance in Maine, and that State alone yields annually between 100,000 and 200,000 skins, most of which are shipped to Philadelphia where they are prepared for shipment to Paris, chiefly in the guise of "monkey" skins. Skunk-farming has become established as a regular business in some parts of New England and the Middle States, and is regarded as quite profitable. The animals become used to attendance and rarely annoy by discharging. They are killed when grown, the bodies used as fertilizer, and the foul smell of the skins removed by heat and smoke. Skunks are trapped, killed with clubs or by means of dogs especially trained to pounce upon them before the fluid can be discharged. Their bodies yield an oil used in making liniments, and the flesh is sometimes eaten and reported as being very sweet and tender.

Skunks usually raise from 6 to 10 kittens in a season. If taken young they are easily tamed and make pretty pets, for they are cleanly in habit and rarely emit their offensive secretion save when provoked. The families remain together for about a year, and during the coldest months of winter they all hibernate together in the same burrow. It seems to be fully established that the skunk is affected with a disease similar to canine rabies and that fatal cases of hydrophobia have resulted from the bite of even apparently healthy animals.

The skunks of the genus *Spilogale* are smaller and differ in the depressed skull, unarched above. The white stripes are more numerous and often incomplete. The 12 described species are mostly confined to the western and southern portions of the United States and to Mexico. One species, the little striped skunk (*S. ringens*), is abundant from Florida to Virginia and westward to Mississippi. It is about 14 inches long, with a broad white patch on the forehead, four white parallel dorsal stripes much broken behind, and a white tip to the tail. The third genus (*Conepatus*) has only 32 teeth, one of the upper premolars being absent, and differs in other respects from the foregoing. *C. mapacito* is the typical skunk of South and Central America and this or a closely related species extends through Mexico into Texas. Except that it does not hibernate its habits are essentially like those described for the common skunk. Consult Coues, 'Fur-bearing Animals' (Washington 1877); Merriam, 'North American Fauna, No. 4' (Washington 1890); Ingersoll, 'Wild Neighbors' (New York 1897); Halbrook, F. M., 'Skunk Culture for Profit' (Chicago 1915).

SKUNK-CABBAGE, a common plant (*Spathyema fœtida*) of the order of *Araceæ*, found in colonies in bogs in eastern North America, and also in Asia. It begins to bloom in winter and the spathes, which are pushed through the mud thus early, are cowl-like, having a twisted point overhanging the orifice; they are fleshy, curiously mottled with purples, greens and yellows, and protect a round spadix in which four-merous perfect flowers are imbedded. These are purplish and are the first pollen-bearers to be visited by bees.

SKUPSHTINA, skûpsh'tĭ-na, the national assembly of the Servians. See SERVIA.

SKY. See ASTRONOMY; ATMOSPHERE; CLOUDS.

SKY-ROCKET. See PROJECTILES.

SKYE, ski, Scotland, the largest island of the Inner Hebrides, off the western coast of Inverness, covers an area of 643 square miles. Its longest dimension is 48½ miles but no point is over five miles from the salt water. Its scenery is celebrated. The deeply indented coast is lined by bold and lofty cliffs or basaltic pillars; the interior is mountainous moorland, interspersed with lochs. The Cuillin Hills at the south form the highest points of land, Banachdich being the highest, 3,234 feet, while toward the east, Blavin reaches an elevation of 3,042 feet. The Red Hills (2,403 feet) rise toward the northeast. The acreage under cultivation is very small and there are few trees. The climate is variable and moist. Much of the land consists of pasturage. Sheep and cattle are raised, and fishing is a chief occupation. The famous castles of Armadale, Duntulm and Dunnegan draw many summer visitors. Loch Coirnisg, lauded by Sir Walter Scott in 'The Lord of the Isles,' is a small fresh-water lake near the Bay of Scavaig. Portree, the chief town on the east coast, has a good harbor and is the southern terminus of a steamer line. Seals are sometimes still seen on the most isolated rocks, and formerly there were walrus. There is a distillery at Carbost, where a well-known brand of whisky is produced. The eastern end of the island is very close to the mainland at two points, where there are ferries. The greatest population was attained in 1841, being 23,082; it has since steadily diminished, a recent estimate being 13,000. Gaelic is spoken more than English.

SKYE TERRIER. See TERRIER.

SKYLARK, a European lark (*Alauda arvensis*), one of the most popular European cage birds from the variety and power, rather than the quality, of its song, and the ease with which its health is preserved in captivity. It inhabits all of Europe, many migrating south in winter. The adult male is about seven inches long; crown dark brown with paled edges, forming a crest, upper parts brown, each feather with a spot of darker hue; throat and upper part of breast grayish-brown, spotted with dark brown, abdomen yellowish-white, deepening into pale brown on the flanks, tail feathers various shades of brown. The female is a little smaller than the male.

The bird is famous wherever English is spoken and English poetry is read, for its flight-song, begun in early spring, and continued all through the summer. When it first rises from the earth, its notes are feeble and interrupted; as it ascends, however, they gradually swell to their full tone, and long after the bird has reached a height where it is lost to the eye, it still continues to charm the ear with its melody. It mounts perhaps more perpendicularly than any other bird, and by successive springs, and descends in an oblique direction, still chanting its rippling music.

The female forms her nest on the ground within some depression, which serves to hide and shelter it — often in grainfields. She lays four or five dirty white eggs, blotched and spotted with brown; and she generally produces two broods in a year. These prolific birds live on seeds and insects; they are most abundant in the more open and highest cultivated situations abounding in grain. In winter they assemble in vast flocks, grow very fat, and are taken in great numbers for the table, especially in the Mediterranean region. Consult Boubote, 'Birds of Great Britain' (1907).

SKYROS, skī'rŏs, Greece, an island of the Ægean Archipelago, 25 miles northeast of Europos, and about 100 miles west of the mainland of Asia Minor. It is 18 miles long by seven wide. There is a large mountain at either end, Olympus on the north, 1,207 feet, and then a comparatively level isthmus to Kokhila on the south, 2,608 feet. The higher grounds are densely wooded, but Olympus has fertile slopes. The products are wheat, wine, oil and oranges. The raising of livestock — especially goats — is a considerable industry; also a species of small horses. A Greek monastery occupies the greater part of the modern Skyros. Theseus, the hero of Athens, died here and his bones were carried to that town when under Kimon the Athenians took Skyros. The only town is also named Skyros and its population is about 4,000.

SLADEN, Douglas (BROOK WHEELTON), Anglo-Australian author: b. London, 5 Feb. 1856. He was graduated at Trinity College, Oxford, and became professor of history in the University of Sidney. He traveled extensively in Egypt, Sudan, Japan, China, Australia, Canada, United States and southern Europe. He won the Spencer Cup for rifle shooting in 1874 and collected hunting trophies and curios from all over the world. He made extensive comparative studies in architecture during his travels. Among his numerous published works are 'Frithjof and Ingebjorg' (1882); 'Australian Lyrics' (1882); 'Poetry of Exile' (1883); 'A Summer Christmas' (1884); 'In Cornwall and Across the Sea' (1885); 'Edward the Black Prince' (1886); 'The Spanish Armada' (1888); 'Australian Ballads and Rhymes' (1888); 'A Century of Australian Song' (1889); 'Australian Poets' (1889); 'Lester the Loyalist' (1890); 'Younger Australian Poets' (1891); 'The Japs at Home' (1892); 'On the Cars and Off' (1895); 'A Japanese Marriage' (1895); 'Brittany for Britons' (1896); 'The Admiral' (1898); 'Trincolox' (1898); 'In Sicily' (1901); 'Playing the Game' (1904); 'A Sicilian Marriage' (1905); Carthage and Tunis' (1906); 'The Secrets of the Vatican' (1907); 'Egypt and the English' (1908); 'The Tragedy of the Pyramids' (1909); 'Oriental Cairo' (1910); 'The Unholy Estate' (1912); 'The Curse of the Nile' (1913); 'Germany's Great Lie'

(1914); 'Twenty Years of my Life' (1915); 'His German Wife' (1915); 'The Douglas Romance' (1916); 'Grace Lorraine' (1917); 'In Ruhleben' (1917); 'The Shadow of a Great Light' (1917). He has also collaborated with Norman Lorimer, Eustache de Lorey, Mrs. E. N. Humphry, O. M. Potter.

SLAFTER, Edmund Farwell, American historian: b. Norwich, Vt., 30 May 1816. He was graduated from Dartmouth in 1840, took orders in the Episcopal Church and held rectorates in Massachusetts prior to 1877. He is the author of 'Sir William Alexander and American Colonization' (1873); 'Voyages of the Northmen to America' (1877); 'John Checkley, or the Evolution of Religious Tolerance in Massachusetts Bay' (1897); and other historical books and monographs.

SLAG. See Metallurgy; Smelting.

SLANDER, a false and malicious oral defamation which tends to injure or disgrace the person so defamed. The chief difference between slander and libel is that the latter refers to malicious defamation expressed by writing, printing or illustration. The law draws a wide distinction between the two actions. Words are held to be actionable, whether or not special damages are shown to have accrued from the defamation, if they impute a criminal offense against the law; the having of a contagious disease; or if they are such as would affect one injuriously in his profession or trade. If the words are not so actionable, yet false and malicious, the party aggrieved cannot recover unless able to prove that he has sustained some certain actual loss therefrom. If the party charged with slander prove that the words complained of are true, no action will lie for defamation, whether or not the words are actionable, for in that event the law holds them to be justifiable. Charging one with having committed perjury has always been regarded as being actionable and in many jurisdictions it is so provided by statute. Words which in themselves are not actionable may in reality be so through an allusion to some collateral facts, or through being used and understood in some particular sense and in such cases, when the offensive sense is proved, it is held to be slanderous. Words in themselves slanderous may be accompanied by explanations which deprive them of that character. There are certain kinds of communications which are regarded as privileged and are, therefore, not actionable, as, for example, the statement made in a judicial proceeding, or where one communicates to another a circumstance which he has the right to know relating to a matter of mutual interest; however, this privilege will not justify slander if malice be shown. Slander does not exist if the injurious words are not uttered within the hearing of a third person. Consult Newell, 'Law of Slander and Libel' (1919). See Defamations; Libel.

SLANG (probably of cognate origin with the Norwegian word *slengja,* meaning «to fling»), a mode of speaking or writing peculiar to some particular place or calling. The slang of the English tongue corresponds to the French *argot* and the German *Saüversprache* or *Rotwelsch.* The word *slang* is itself slang in origin: it has nothing, etymologically considered, to do with any Gipsy word as has sometimes been asserted. Of obscure origin, its form nevertheless suggests a connection with the English word *sling,*— in the sense of this latter word as employed in the phrase *to sling* (that is, *to fling*) «*reproaches*». All colloquial words or phrases which have originated in the rude speech of vagabonds and unlettered classes or belonging in form to the standard speech, which have acquired or have had given them restricted, capricious, or extravagantly metaphorical meanings, and are, therefore, regarded as vulgar or inelegant, may be considered as slang. Among slang names may be mentioned, in general, that class of words and phrases and senses of words and phrases, more or less artificial and affected in origin or use, which are not recognized as belonging to the standard vocabulary of a tongue into which they have been introduced, and have currency in some section of society either as a means of concealing secrets or as intentionally undignified substitutes for those modes of expression employed by persons who have themselves no propriety of speech. Slang is indeed used by persons of every grade of life; it changes with fashion and taste; and sometimes leaves permanent and recognized additions to language. It consists of words which stand out predominantly even in colloquial speech; and the very sense of the word slang implies the conception of a standard language, a normal form of speech, popularly regarded as correct. Slang differs much from dialect, for the latter is a local or provincial form of speech, characterized by some peculiarities of accent, pronunciation or grammatical usage which distinguishes it from standard speech; and a dialect as much may thus have a slang of its own. It is true, however, that slang shades off into the ordinary colloquial speech and is thus constantly supplying the ordinary spoken language with new words and phrases, but this should be no reason why it should be simply confounded with the colloquial. In truth, slang enters more or less into all colloquial speech and into inferior popular literature such as novels, newspapers and political addresses; and is apt to break out even in more careful writing, as witness the criticism of Henry James in his 'Notes on Novelists.' It is noteworthy that most slang is euphemistic. It delights in the invention of synonyms for particular words and devises substitutes for others, which well-bred people for a variety of reasons dislike or hesitate to use. Yet it cannot be said that all slang is of necessity vulgar or ungrammatical. For indeed it is generally correct in accidence and syntax and does not disregard phraseological idiom as to its structure; and thus, while slang not infrequently meets censure as vulgar or unidiomatic, the truth is that it meets with disfavor on other than grammatical grounds. The vogue of any particular slang expression is apt to be very brief; and the constant use of slang tends not only to vulgarize but to limit one's command of language: and here we probably find the reason why it is held in disfavor. Further: slang words are not invented or used because they are in any respect better than accepted phraseology, but because they are *different.* There are two principal characteristics which, taken together, may serve to distinguish what is properly called slang from other varieties of diction that in some respects resemble it; and these are: Firstly, slang is a conscious offense against some accepted standard of linguistic propriety.

Secondly, slang words are deliberately substituted for words of the vernacular just as the nickname of a person is substituted for that person's name. Nicknames are indeed a kind of slang; and like other slang may be used for the purpose of concealing meaning from the uninitiated hearers.

A mere vulgarism is not slang excepting when it is purposely adopted and in the process acquires an artificial currency among a class of persons to whom it is not native. By «vulgarism» may here be understood such colloquial expressions which are rejected as undignified by speakers of a certain grade in the scale of culture.

Ancient Greek and ancient Latin each had its slang; its argot. See in this connection the plays of Aristophanes, the comedies of Plautus, the satires of Horace, Persius and Juvenal; and especially the surviving, serious fragment of Petronius, known as the 'Satiricon.' Likewise every modern European tongue has its quantum of slang. From the 17th century onward it has been more and more difficult to distinguish between English cant of the thieves and vagrants and slang of other classes more or less characterized by disorderly habits of life, such as pugilists, strolling players, professional gamblers — in brief, of all such classes as are addicted to low pleasures and vices. The specimen of the earliest English «cant» or «Peddler's French» in Copeland's 'The Hyeway to the Spyttel House' (1517) bears characteristics that resemble closely those of the German *Rotwelsch* of the same period. An example of the latter may be found in the Old High German Liber Vagatorum of 1510; and it is easily seen that the most noteworthy point of difference between Peddler's French and 16th century Germanic *Rotwelsch* lies in the absence of those Hebrew words from Peddler's French in which *Rotwelsch* abounds. In the English of Hudibras and the literature of England, dating from the 18th century, slang is to be found. A peculiar growth of the 19th century is the so-called back slang, current chiefly among London coster-mongers, which is a cryptic jargon formed by pronouncing words backward, as in the phrase, «eno dnuop and a flah,» for «one pound and a half, thirty shillings.» When Sir Walter Scott wrote, the word *slang* itself had apparently no wide currency, and that author felt the need of defining it for his public in one of his works. He seems to have meant what is practically thieves' cant in using the word, but nowadays one should understand by thieves' cant merely one species of an extensive group of expressions called slang. (Consult Scott's 'Redgauntlet'). Coster-monger's slang is thieves' slang, in which the middle vowel of a word is taken as the initial letter so the other letters or syllables are added to give it, as it were, a finish; thus, *lock* becomes *ockler* and *pitch, itchper.* Slang, and cant in particular, as in the phrases «thieves' cant» or «printers' slang,» or the cant of any craft or calling, really designates a language within a language, and it is sometimes intended to conceal the thoughts of those who utter it from the uninitiated. There is a slang attached in this way to nearly every profession and occupation; and different classes of society have their slang. Thus there is a slang of commerce, of the army, of the race-track, of the college and school, of the stock exchange, of the prize ring, of the ball field, of politics, and even a slang of art and the ministry. Very often slang adopts technical language to the general use; its expressions may be perfectly correct as originally used, but they become slang when used metaphorically. The gaming-table, the turf and all the varieties of «fast» or «Bohemian» life, each has its own eccentric vocabulary, and these vocabularies are either identical with or in general character resemble the slang of criminal and vagrant classes.

Some examples of slang may now be noted. A user of slang will characterize a feeble-minded or silly person as having a «screw loose,» a «slate off,» «bats in his belfry,» «off his base,» or as being «cracked,» «touched» or «dotty.» He will call his child or wife a «kid.» He will say «rum» for «queer,» «gay» for «dissolute» and call a watch a «ticker.» He will say «corned,» «pickled,» «tight,» «stewed» or «slued» for intoxicated; and use «awfully» as substitute for exceedingly. «Daisy» with him will characterize some person who is charming or some thing which is admirable; and the user of slang will announce the death of a person by telling one that someone has «kicked the bucket,» «cashed in» or «hopped a twig.» To be angry means that he has «got your goat,» and he will allude to the clergyman present as a «sky pilot»; while in a museum he will show you the latest «pot-boiler,» and in so doing he both names and stigmatizes certain works of art.

A habitual user of slang will likewise borrow words like «pan out» from the technical language of gold digging or other pursuits of a similar character; he will use the word «four-flusher» from the language of the professional poker-player, and he will use the slang expressions «deal,» «walk-over» and «up the flume» in giving an account of business. In his vocabulary of praise and blame one will find expressions such as «ripping,» «swagger,» «stunning,» «the cheese,» «rot,» «poppy-cock»; and when he is in some difficulty he will be «in a hole,» «in a box,» «on his beam ends» or «in the soup.» To extricate himself he will use his head or «nut,» «think-box,» «brain-pan» or «upper story»; and will need money or, as he calls it, «dough,» «mazuma,» «shekels» or «rhino.» To go in public he will don his «glad rags» and appear as a «swell,» «giddy-boy» or «dude.» In this respect he will resemble the older «beaux,» «bucks,» «exquisites,» «gallants,» «sparks» and «blades.» While in the stock exchange one will hear him speak of «bulls,» «bears,» «lambs,» «longs» and «shorts,» and from the side of the prize-ring one will find him awaiting to see a «knock-out» and always willing to disapprove of a blow «below the belt»; and he will be disappointed should one of the pugilists «throw up the sponge.» One recent contribution to the vocabulary of slang is the word «jazz,» which originated in the southern States, and means, according to a user's own definition, «to mix things up and spread 'em on thick»; in other words, a medley. Thus it appears that nearly every trade and every profession has a slang of its own in the shape of a body of words and expressions that serve as flippant and undignified substitutes for standard speech.

The contribution made by foreign languages to English slang, although it is not to be disregarded, is not to be overrated as to its extent. There are a few words — «boss» from the Dutch *baas*, dago from the Spanish *Diego*, *spiel* and *bum* from the German, which may be named as of foreign origin. The Romany, or tongue of the Gipsy, gave English the words «cove,» «jockey,» «mug» and «pal,» which may be considered as slang expressions, and the English phrases, «not half bad» and «a very decent fellow» are, carefully considered, slang expressions and represent the rhetorical figure called meiosis. There are, it is true, words that are no longer slang («mob,» «humbug» and «tandem» are examples) that were once so considered. America has contributed its quota to the slang of the English tongue; of such we might name the following expressions, recommended mainly by their oddity: «scallywag,» «absquatulate,» «skeddaddle,» «vamoose» (from Sp. *vámos*, «let us go»); and English has also these substitutes for standard usage to characterize political life — «mugwumps,» «gerrymander,» «carpet-bagger»; as well as the older «Rump,» «Bare-bones Parliament,» «Roundhead,» «Puritan,» and so on. So politics also has its «slates,» «wire-pulling,» «pipe-laying,» «log-rolling» and «filibustering.» Expressions such as the foregoing, stigmatized at first as pure slang, are often in the end accepted as legitimate; just as have been the words «poney,» «cob» and the term, «slang» itself.

As the prevailing tendency of words in a language is toward degradation of meaning one of the most frequently recurring needs of English is that of words of dignified and serious intention to take the place of words which have become vulgar through ignoble use; and, therefore, it may be believed that while slang has made its contribution to the English language, still that contribution has been, on the whole, small.

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SLATE, a clay rock which has been subjected to compression during mountain-making processes in the earth's crust, and which as a result splits readily into thin sheets or cleavage laminæ in a direction at right angles to the direction of compression. According to Sorby, cleavage is produced in such rocks by the rearrangement during compression of the plastic particles comprising the original rock mass, in such a manner that their longer axes come to lie perpendicular to the direction of compression, and that planes of easy fracture were thus produced parallel to the long axes of the particles. This was illustrated by Sorby, with a cube of clay through which mica scales or scales of oxide of iron were sprinkled, which was then subjected to powerful compression and drying. A perfect cleavage at right angles to the line of pressure was produced, and microscopic examination showed that the mica scales lay in the direction of cleavage. Tyndall found by experiment that cleavage is more perfect in proportion in which the cleaved material is free from foreign particles, such as mica scales, and he considered that cleavage was produced in homogeneous rocks (except the vitreous) by the compression and flattening of the minute discrete granules or particles of which all such matter consists. The structure is changed by the compression from granulous to scaly. Enormous vertical swelling of the rock masses results through such lateral compression, and this swelling is an important factor in the formation of mountains.

Ordinarily cleavage exists in rocks in a potential manner only — the rock is cleavable in a certain direction, but no actual separation takes place. This, however, is rapidly developed when the rock mass is exposed to atmospheric influences. Slates are quarried in solid blocks and split up in thin sheets, usually by hammer and chisel after quarrying. The important slate-producing horizons of eastern United States are the Cambrian and Ordovician beds of the Taconic range of eastern New York and its extension in Vermont, and the corresponding formations of Pennsylvania and other regions in the northern Appalachians. In composition slates vary greatly, especially in the proportion of silica. An analysis of common roofing-slate gave the following: Silica, 48; alumina, 25.50; oxide of iron, 11.03; potash, 4.70; magnesia, 1.60; carbon, .30; water, 7.60. Since slate is in reality a structural term, denoting the property of easy splitting so characteristic of roofing slates, rocks of almost any composition may be indexed under this term, provided they show the characteristic slaty cleavage. Thus it has become customary to speak of anthracite slate, in which a considerable percentage of carbonaceous material is present; whet slates — clay slates, with a large percentage of silica, often nearly pure silica (Novaculytes); talc slates and chlorite slates, where those minerals are prominent; gray-wacke slates, more or less arenaceous and micaceous slates. Roofing slates, however, are the typical slates, and the ones in which the slaty cleavage is best developed. The most important localities for these in the United States are Vermont and Pennsylvania.

The slate belt of Pennsylvania first appears in the eastern corner of York County and «then sweeps around in a gradually narrowing curve to the Susquehanna River.» It reappears on the eastern bank of the Susquehanna in Lancaster County, but can be traced for a comparatively short distance from the river. While this belt is quite limited in extent, being but six miles long and less than one mile in width, it is nevertheless producing a very high grade product. It is from this belt that the well-known «Peach Bottom Slate» has come. It has remarkable strength and durability, exceedingly fine in grain and texture and the very desirable quality of retaining its original color even after continuous exposure for many years. It lacks the high degree of fissility, however, that characterizes other localities. Microscopic study of thin sections from this belt shows, according to Merrill, that the slate is not fragmental in character, but on the other hand is a «highly carbonaceous, crystalline schist.» This is attributed to the high degree of metamorphism to which the belt has been subjected. Bangor and West Bangor are the centres of greatest activity. The belt continues for a short distance into Maryland where a few smaller centres of production are located. Maine follows Vermont with a valuation of $202,325 for 1901. There are five areas of note in the State. One of the two larger belts extends from Franklin County northeastward to Aroostook County, thence northward into New Brunswick. The second passes from the western boundary of Somerset County, in an easterly direction to Houlton, Aroostook County. «Of the three smaller areas, one is on the Kennebec River, south of Skowhegan and the two others in Washington County, about Baskahegan Lake and near Princeton.» Only portions of the two larger areas produce slate of a medium or high grade.

Colorado, Dakota, Massachusetts, Michigan, Minnesota, New Hampshire, Tennessee, South Carolina, Texas and Virginia are known to contain slate terrains of more or less importance. Very little effort, however, has been put forth to develop the slate industry in these respective States.

An inspection of the most recent statistics reveals the fact that there are now some 14 productive States in the Union. Pennsylvania takes the lead, with an annual valuation of $3,609,957 for the production of 1914. Vermont takes second place with a valuation of $1,414,247 for 1914. The valuation of the slate production of the following States exceeded $70,000; these are Maine, Virginia, New York and Maryland. Arkansas, California, Georgia and New Jersey also yield small amounts. In 1914 the valuation of the total production of the United States was $5,706,787. The latest addition to the list of producers is the State of Arkansas.

Export trade in roofing-slate reached its highest mark in 1898 with a valuation of $1,370,075. Great Britain was the chief importer of our product at this date. From the above date, however, our exports materially decreased. This was in the main due to the settlement of strikes in the Welsh quarries and the consequent development of the slate industry in Wales. British Australia and Denmark were also importers of the American product. In 1914 exports had dropped to $139,125.

One of the most remarkable slate belts of this country lies in eastern New York and western Vermont, between the Taconic range on the east and Lake Champlain and the Hudson on the west, and chiefly between the Hoosic River on the south and the towns of Benson and Hubbardton, in Vermont, on the north. It attains a maximum length of 68 miles and an average width of about seven miles. The great producing centres lie in Washington County, N. Y., and Rutland, Vt.

The slates in this field are green of various shades, purple, variegated, that is, mixed green and purple, red and also black. See SHALE; SEDIMENTARY ROCKS; MINERAL PRODUCTION OF THE UNITED STATES.

A. W. GRABAU,
Columbia University.

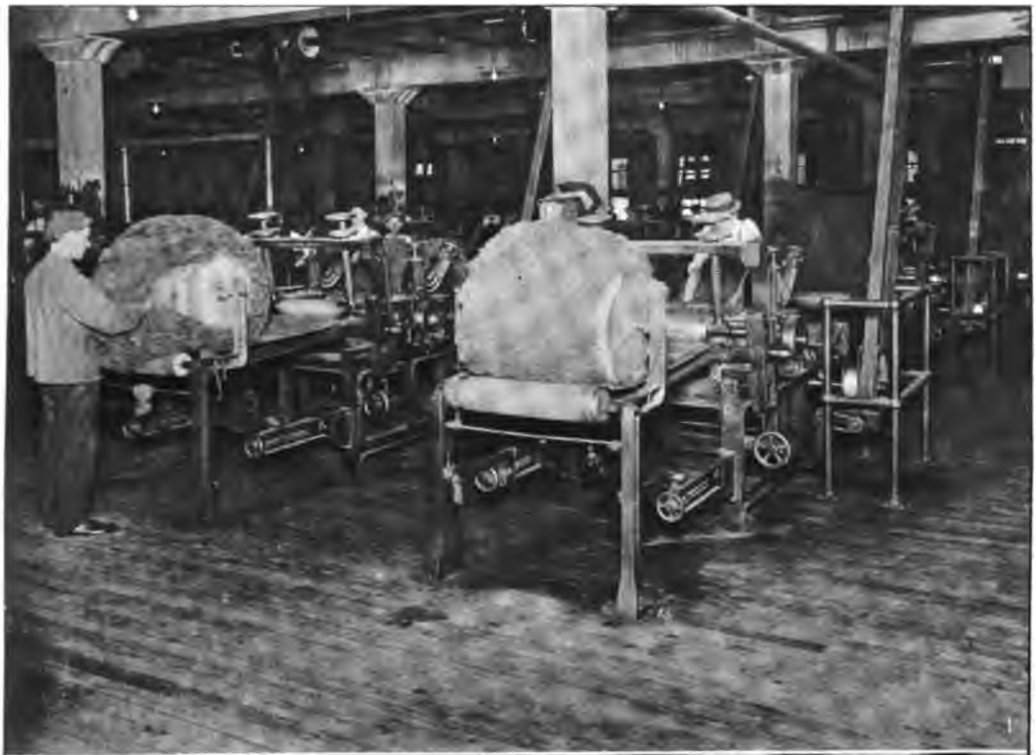
SLATER, John Fox, American philanthropist: b. Slatersville, R. I., 4 March 1815; d. Norwich, Conn., 7 May 1884. He inherited from his uncle, Samuel Slater (q.v.), the cotton spinning enterprises which he had founded, and so managed them as to acquire a large fortune. He contributed generously to the establishment and maintenance of the Norwich Free Academy and other similar institutions, but is best known for his gift of $1,000,000, forming the «Slater Fund,» for the education of freedmen in the South. For this benefice Congress voted him a resolution of thanks and a medal. See SLATER FUND.

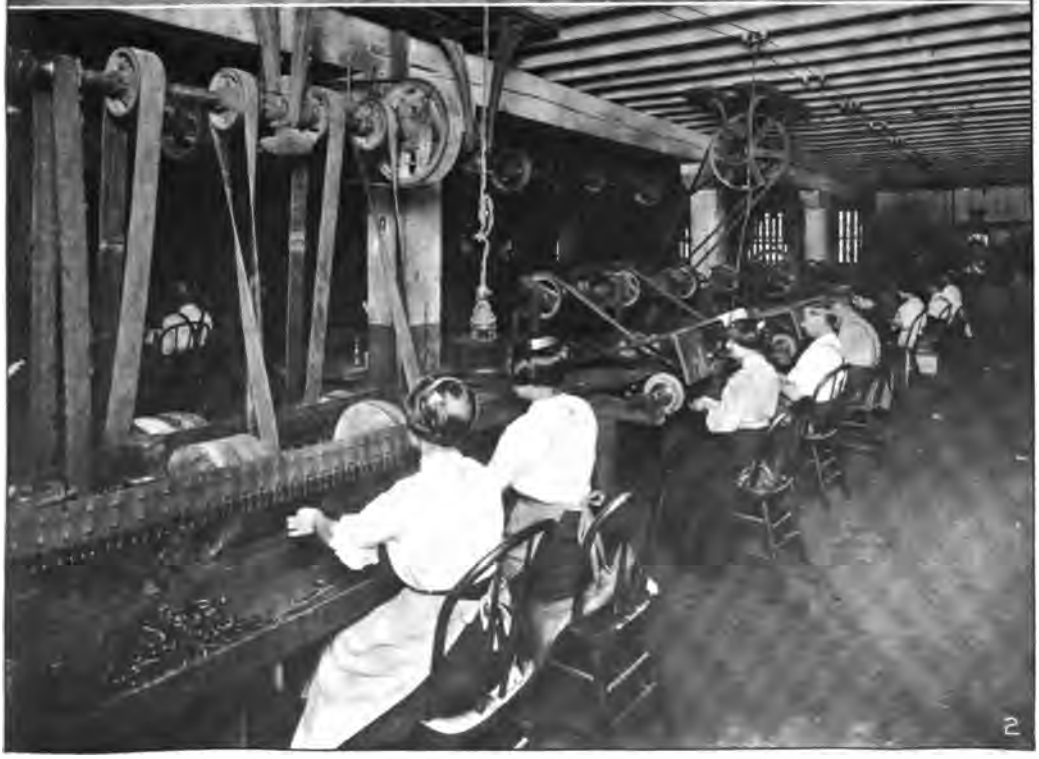
SLATER, Samuel, American manufacturer: b. Belper, Derbyshire, England, 9 June 1768; d. Webster, Mass., 21 April 1835. He had worked under Arkwright and Strutt in the cotton factories in England and had helped in devising some of the machinery used there, and hearing that a bounty had been offered in the United States for the introduction of the Arkwright patents, he came to this country determined to win it. As the English law forbade the exportation of drawings or models of the English machinery, Slater had to depend entirely on his memory for the mechanical details. He succeeded in constructing at Pawtucket, R. I., the first cotton mill in the United States. He afterward established mills at Oxford (now Webster), and in a locality now known as Slatersville, R. I., where a town of 1,850 people depends mainly on the Slater factory.

SLATER, Mo., city in Saline County, 85 miles northeast of Kansas City, on the Chicago and Alton Railroad. It was settled and incorporated in 1878 and received its city charter in 1884. It is situated in a productive agricultural region and has a flour mill and grain elevator. Pop. 3,238.

SLATER FUND, the gift of John Fox Slater, of Norwich, Conn., to the cause of educating the negroes of the South, was originally the sum of $1,000,000. The gift was made in 1882, to a board of trustees, who were to hold the principal and expend the interest in promoting institutions already established on a permanent basis. In acknowledgment of this philanthropy Congress voted the donor thanks and a medal. By the terms of the gift neither principal nor income is to be expended on buildings or grounds. The fund is expended principally in helping students of, and preparing teachers for, the manual training schools, agricultural and mechanical colleges and technological institutions. Rutherford B. Hayes, Dr. D. C. Gilman, Morris K. Jessup, Bishop Potter, Wil-

SLAUGHTERHOUSE BYPRODUCTS





1 Curled hair Machine. After the hair has been twisted into ropes for curling and processed, it is untwisted, separated and carded by these machines

2 Finishing horn hairpins, which have been stamped from horns which have been slit open, heated and flattened out into plates

liam E. Dodge and many other prominent men have served on the board. The fund is as a potential agency in working out the problem of the education of the negro, and $1,000,000 has already been expended. By the extraordinary fidelity and financial ability of the treasurer, the fund, while keeping up annual appropriations, has increased to $1,500,000. Schools established by States, denominations and individuals, are helped by annual donations. Among the most prominent are the Hampton Normal and Industrial, the Spelman, the Tuskegee, and schools at Orangeburg, S. C.; Tongaloo, Miss.; Marshall, Tex.; Raleigh, N. C.; New Orleans, the Meharry Medical College at Nashville, etc.

SLATIN PASHA, slä'tĕn pa-shä (RUDOLF CARL), Austrian soldier: b. Vienna, 1857. In 1874 he undertook a journey to the Sudan, where he made the acquaintance of General Gordon, who, four years later, while Slatin was serving in the Austrian army on the Bosnian frontier, invited the latter to take service with the Egyptian government. In December 1878, at the age of 22, he set out for Khartum. Gordon appointed him successively financial inspector, mudir of Dara, and governor-general of Darfur. In the last-named post he played a prominent fighting part in the struggle against Mahdism. He fought 27 battles, lost a greater part of his Egyptian army and was finally forced to surrender (1884). For 11 years he was a prisoner of the Mahdi and, later, of the Khalifa, being kept in heavy chains most of the time. After his escape he accompanied the British troops in the campaigns of Dongola, the Atbara and Omdurman. He was knighted by Queen Victoria in 1898 and was appointed inspector-general of the Sudan in 1900, a post he resigned in 1914. The British honors conferred upon him include the K.C.M.G., C.V.O., K.C.V.O., G.C.V.O., besides the rank of major-general. These distinctions he renounced in December 1914. His African adventures and long captivity are described in his book, 'Fire and Sword in the Sudan' (New York 1896). He was a member of the Austrian peace delegation in Paris, May 1919.

SLATINGTON, Pa., borough in Lehigh County, 58 miles northwest of Philadelphia, on the Central of New Jersey, the Lehigh Valley and the Philadelphia and Reading railroads. The scenery is unusually fine, Blue Mountain and Lehigh Gap both being nearby. It was settled in 1738 and was incorporated in 1864. There are slate quarries and manufactures of slate roofing, as well as of machinery, rolling mills products, knit goods and silks. Pop. 4,454.

SLAUGHTER-HOUSE. See ABATTOIR.

SLAUGHTER-HOUSE BY-PRODUCTS. From the viewpoint of the general public, fresh meats are perhaps the most important item in the whole range of commodities which the individual is ever called upon to buy. Yet, from the viewpoint of packers' profits, the by-products of meat packing long ago outstripped dressed beef, pork and mutton, as well as pickled meats of all kinds.

The packer to-day makes little or no money on what are known as carcass meats. In the recent years of struggle with «rising costs» livestock raisers have demanded higher and still higher prices for cattle, hogs and sheep, not only because the cost of feeds and help have risen, but also on the ground that the quality of their animals, in point of breeding, of finish and tender age of marketing, has constantly improved.

On the other hand, there has been a determined resistance on the part of the consumer to the rising cost of steaks, roasts and chops, as well as constant and widespread agitation throughout the country for higher standards of cleanliness, sanitation and efficiency in methods of dressing, refrigeration and distribution of meats.

Nearly All Profit Eliminated from Dressed Meat.— Efficient and economical operation on a large scale has made it possible for American meat packers to continue in business in spite of increasing cost of livestock, labor, and all material and equipment. They have paid producers the highest prices and have kept their own margin of profit down to the lowest point consistent with safety. Higher standards of meat products have been maintained as a result of United States government inspection.

The producer on the one hand, and the consumer on the other, have each been so jealous of middleman's profits that the middleman, who in this case is the packer, has been forced almost entirely out from a profit viewpoint. In point of service, however, the packer is still in evidence and the slaughter, dressing, chilling and distribution of these dressed meats are still performed by him.

The outcome of such a situation is that the butcher of to-day regularly pays the packer for the dressed carcass a less amount than the packer paid the farmer for the animal before it was killed, dressed, chilled and shipped.

By-Products Pay Packers' Profits.— It will thus be seen that on carcass meats alone the packer loses money, being obliged to maintain, for the distribution of these profitless perishables, an elaborate system of branch houses and refrigerator cars.

This is not to say, however, that the packing business as a whole is devoid of profit. Only approximately 55 per cent of the live weight of a steer is represented in the dressed carcass. In the remaining 45 per cent, which is made up of blood, hide, hoofs, horns, bones, hair, intestines, glands and other items of offal, the packer finds opportunity to recoup himself for any loss he may sustain on carcass meats and ensure a fair return upon his whole investment.

In the early days of the meat packing business all of these items, with the exception of hides, were discarded as of no account. They were, at that time, contemptuously referred to as «the revolting nuisance of packers' waste,» which could not be given away, much less sold, and the expense of getting rid of them by other means ate into the profits which then existed in carcass meats.

First Utilization of By-Products.— In the decades since the Civil War, but principally since the introduction of mechanical refrigeration on a large scale, about 1870, a gradual change has been coming over the packing industry in this regard. Small quantities of the bones, ears and hide trimmings began to be utilized in the manufacture of glue at the Chicago stock yards as early as 1869. The value of dried blood as an ingredient of fertilizer was recognized in 1870. The canning of meats by the Appert vacuum process became commercially successful before 1875, and then the caul or leaf fat about the kidney of steers was found to be especially rich in oleo oil which forms the principal ingredient of oleomargarine to-day.

From that point on, a large volume would be required to enumerate the discoveries and successes wrought by the hundreds of chemists and other scientific and practical men who have devoted years, if not their entire lives, to the exploitation of this promising field.

From Mere Slaughter-Houses to Great Factory Systems.— The gradual development and commercialization of by-products, however, has involved an ever-growing investment in plants, machinery and distribution facilities, and an ever-broadening pay-roll. The business which was once confined to slaughtering and speculating in dry salt and pickled meats, with a small slaughter-house pay-roll in winter only and none whatever for manufacturing and distribution, has grown to be almost wholly an enormous manufacturing industry which occupies itself the year around at utilizing, in commercial form, all those elements formerly comprehended in what was known as packers' waste.

The hides and pelts of steers and sheep, of course, constitute one of the most valuable by-products of the packing business. These are depilated and tanned, usually by the packers themselves, or by auxiliary corporations, and are made into all forms of leather, from shoe soles and belting to the highly finished and brightly colored leathers for book binding and milady's handbag.

Sharp Refrigeration Saves the Perishables. — The hearts, livers, sweetbreads, kidneys, brains and ox tails which, within the memory of men still in active life, were given freely to whoever would take them away, the remainder being dumped regularly into the river or hauled, along with other waste, to the prairie to be buried in trenches, are to-day quickly frozen, packed and transported with the frost on them in summer as well as winter, for retailing at good prices in distant parts of the United States.

Calves' Pates Make Gelatine — Pigs' Feet are Pickled.— Calves' ears are carefully cleaned and manufactured into edible gelatine. Pigs' feet are pickled and sold as a relish. The stomach of the steer is put through an elaborate cleaning, cooking and pickling process and emerges as honey-comb tripe. Much of the blood of the steer, being caught in buckets, is utilized in the making of "blutwurst" or blood pudding. Large quantities, however, are also used as an ammoniate in fertilizer and by tanners in finishing leather. The milts or spleens are mostly sold to the government and other agencies maintaining fish hatcheries as a food for growing fish.

How Oleomargarine is Made.— Great kettles first boil the suet fat and choice leaf fat which are used in the manufacture of oleomargarine. These fats are reduced to liquid form and are sent down pipes to the presses where the oil is separated. Next comes the salting and churning with uncolored butter and pasteurized whole milk. Oleomargarine is known for its purity and nutritive value, as well as the characteristic butter flavor which it possesses.

Oil and Stearin Separated by Pressure.— When the oleo oil has been pressed from the rendered caul fat of the steer, the hard part of the fat remaining in the press is known as oleo stearin. This, also, is the basis of a commercial product which is sold to be used in the manufacture of chewing gum, as well as taffies, penny candies and chocolates.

The coarser and inedible grades of stearin are sold to tanners who use it as a filler in making leather. Inedible grades of lard are pressed to separate the lard oil from the lard stearin. This oil is used in the compounding of lubricating oils.

How Intestines are Utilized.— The intestines of cattle, hogs and sheep are as rigidly classified, graded and devoted to their special purposes as are all other portions of the animal.

A set of hog intestines, for instance, is classified into the small casing, the bung and the middle gut or chitterling. All intestines are flushed with water and thoroughly cleaned and sterilized inside and out. They are next inflated, assorted according to size, and, if used for sausage casings, are salted down in tierces and kept in cold storage as a regular commodity of trade.

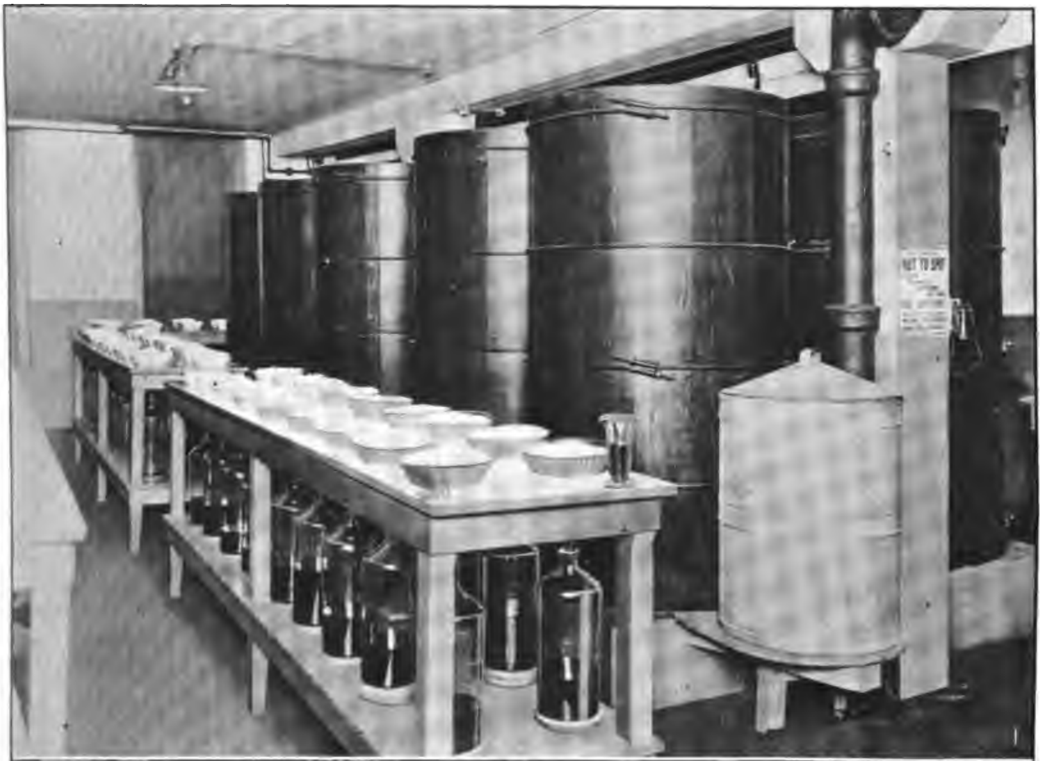
Make Sausage Casings and Violin Strings. — The wide range in size, shape and appearance of casings when filled with sausage is bewildering to the uninitiated, yet the variety is not as great as the range of sausages to be contained in them. Every country on the globe, perhaps, has its peculiar styles and grades of sausage, beef and pork, fresh and dried, smoked and unsmoked, cooked and raw, seasoned and unseasoned, and so on, *ad infinitum*. Each of these styles of sausage is quite distinct and necessary to the nationality for whom it is designed, and the myriad sizes, shapes and appearances of casings, when filled, are indispensable as an identification of the exact style of sausage which they contain.

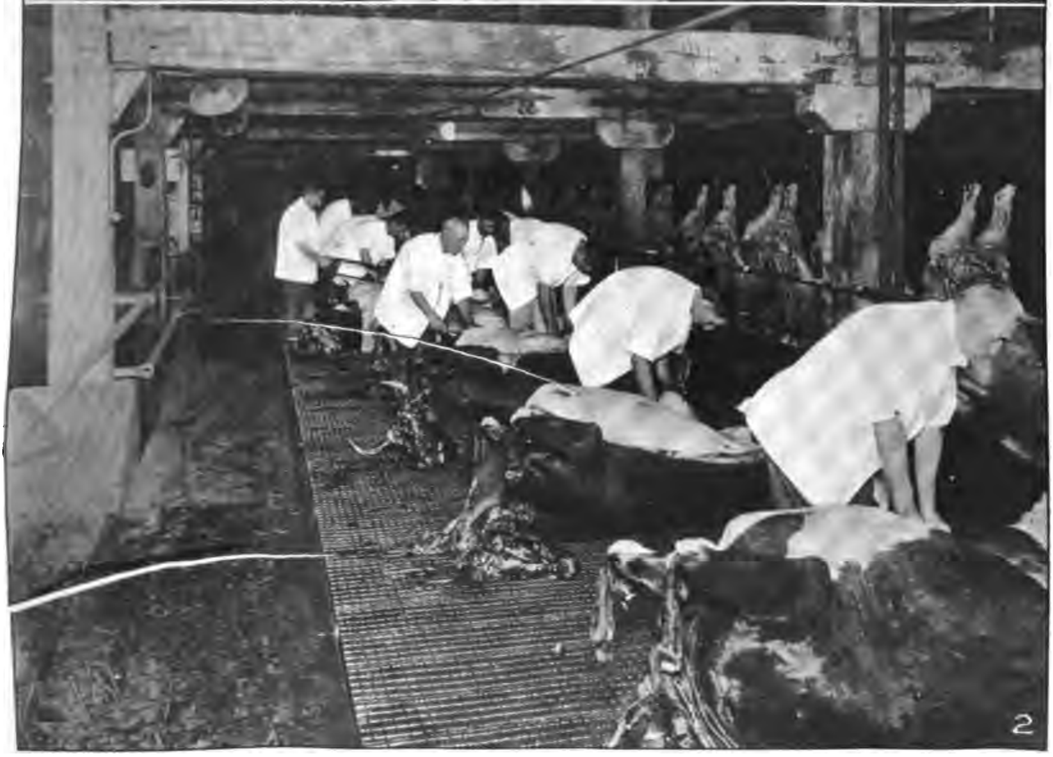
Dried bladders are used as containers for putty and certain other dried tissues as goldbeaters' skins, snuff containers, covers for perfume bottles and as tissue from which balloon envelopes are made.

From the intestines of the sheep many varieties of the best violin and other musical strings are made, the traditional cat gut being a misnomer. Strings for various other purposes are also made, including tennis strings, drum snares, clock cords and surgical ligature.

Novelties Made from Horns, Hoofs and Bones.— The horns and hoofs of cattle are softened by steam, split open and flattened out into plates. From these plates are stamped combs, hairpins, napkin rings, buttons, buckles, knife handles, umbrella handles and other novelties. Black hoofs are also ground up and used as an ammoniate in the manufacture of fertilizer for the use of florists, grape growers and others. The shin bones of cattle are sawed into plates from which pipe bits, buttons, washers, electrical bushings, crochet hooks, chessmen and such articles are made. Soft bones, as well as hide trimmings and sinews, are rich in glue and are devoted to that purpose, the residue being found valuable in the manufacture of fertilizers. The feet of calves and cattle also yield an article commercially known as neatsfoot oil.

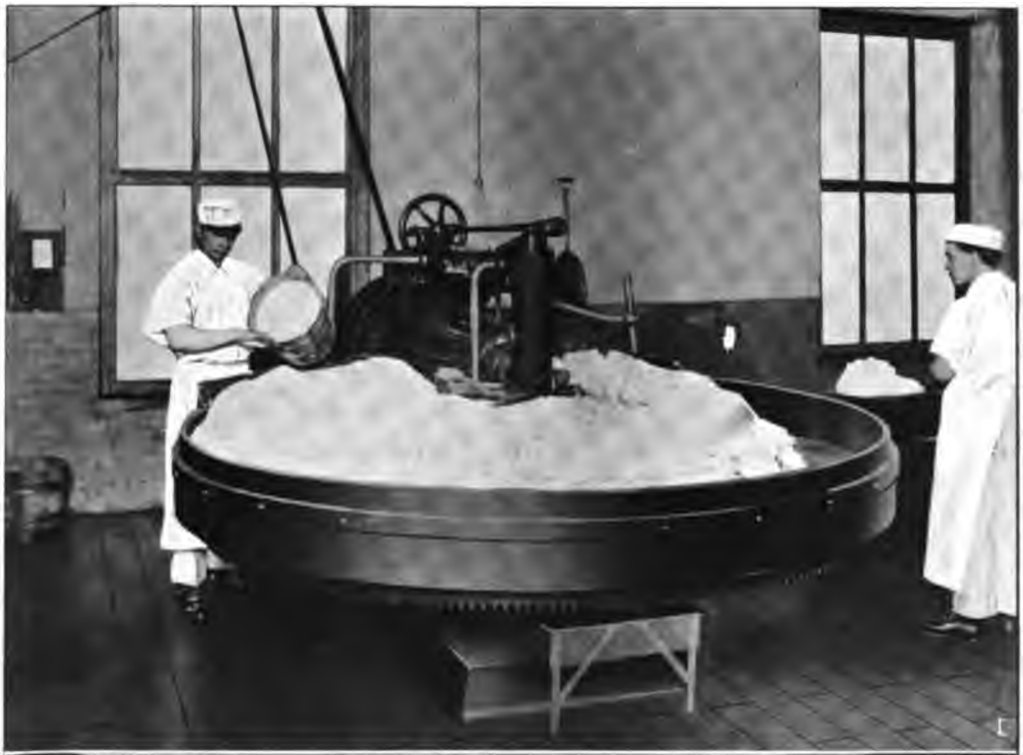
SLAUGHTERHOUSE BYPRODUCTS

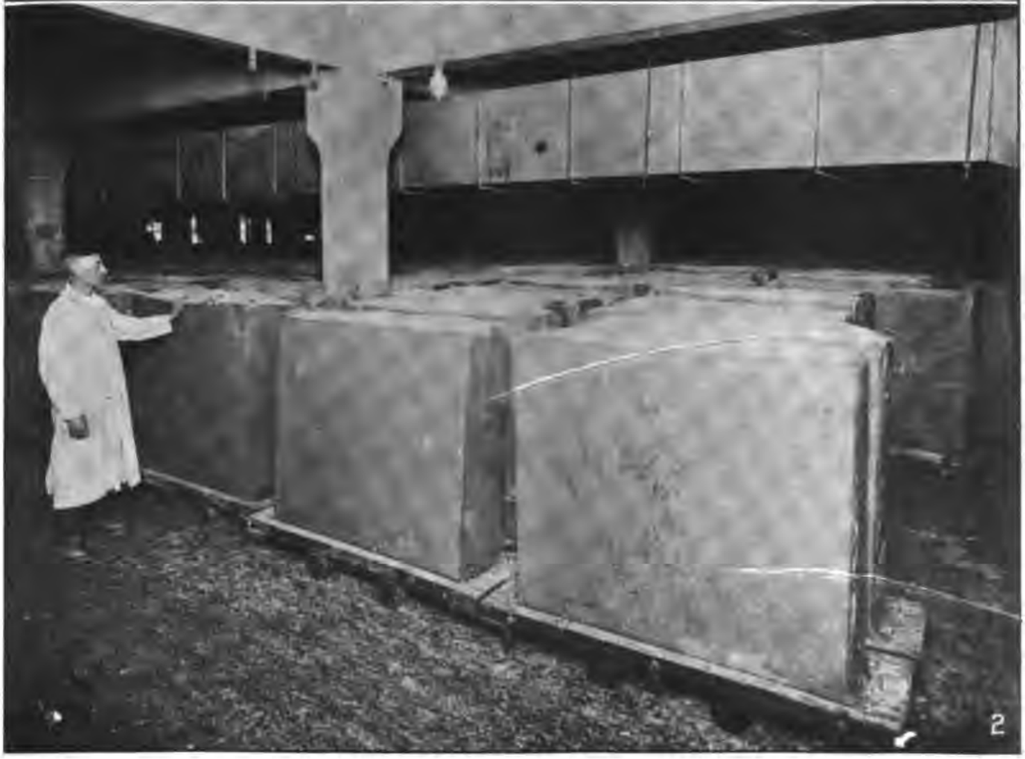




1 Pepsin Tanks, Armour & Company's Pharmaceutical Laboratory
2 Moving Platform showing carcasses traveling away from observer and coming back in a hanging position on an overhead rail as seen in the background

SLAUGHTERHOUSE BYPRODUCTS





1 Mechanical mixer working salt into Oleomargarine — the last process preparatory to putting it in cartons
2 Soap in process of seasoning preparatory to cutting up and stamping into cakes

More than 40 Medicinal Agents.— One of the most important and highly scientific departments to be considered in relation to the utilization of abattoir by-products is the pharmaceutical laboratory. In this department, pepsin in both tablet and liquid form is prepared from the stomach linings of the pig, and rennet, for the use of cheesemakers in the curdling of milk, from the true or fourth stomach of the calf. All told more than 40 medicinal agents are manufactured from the various glands and membranes of cattle, sheep and hogs and sold only through the medical profession, among which, in addition to those already mentioned, are pancreatin, thyroids, benzoinated lard, suprarenals, pituitary liquid and ox gall.

Toilet and Laundry Soaps and Glycerin. — The manufacture of soaps, however, is perhaps the most familiar example of abattoir by-products in the whole list. Soaps are manufactured in infinite variety and on an enormous scale and Chicago soaps, both laundry and toilet varieties, are attaining a degree of perfection that is marveled at even in France. A by-product of soap making is glycerin, which will be recognized by those who have witnessed the process of soapmaking in their own homes in the clear reddish liquid which remains in the kettle after the solidified soap has been removed. This glycerin, after being refined, is used as a vehicle in medicinal preparations. Its greatest use, however, is in the manufacture of dynamite, nitroglycerin and other explosives.

J. Ogden Armour.

SLAUGHTER-HOUSE CASES arose out of laws passed in 1869 by the legislature of the State of Louisiana in an act intended to protect the public health in the city of New Orleans and to that end incorporating The Crescent City Live Stock Landing and Slaughter-house Company. The act gives to this company the sole right «to land, keep or slaughter any cattle, beeves, sheep, swine or other animals . . . within the city of New Orleans, or at any point or place . . . .» on the east or west banks of the Mississippi River, opposite the corporate limits of the city. Included with this privilege, granted to this company and forbidden to all other persons, was the right to establish wharves for the landing of livestock and to levy wharfage on the stock landed at so much per head. This act was bitterly opposed by the butchers and cattle dealers, and after it went into effect an action was brought in the District Court and an injunction obtained on the ground that the law was unconstitutional; when the case was tried the court sustained the injunction and made it perpetual, on the ground that it was in opposition to the 14th Amendment of the United States Constitution (q.v.), and to the first and second sections of the State «Bill of Rights.» In delivering his opinion the judge (Collens) said as follows: «This law (1) prevents any freedom whatever; (2) walls up many miles of the shores of the river on both sides against an important branch of commerce; (3) vests as it were a private company with an ownership in one of the greatest ports of entry in the United States; (4) gives this company alone the authority to 'establish wharves' for vessels bringing livestock into the port of New Orleans; (5) yields it the 'exclusive' right of having one or more stock landings, with the 'exclusive' privilege of having landed at its wharves and landing places all animals intended for sale or slaughter in the parishes of Orleans and Jefferson; (6) authorizes it to determine at what points or places wharves, stock-landings, etc., may be erected; (7) grants it the power of levying wharfage not simply on the vessels, according to tonnage and time, but a round sum on the vessels, and a duty of 10 cents per head on large, and 5 cents per head on small beasts landed in this port; and (8) all this is made effective by penal clauses imposing fines, etc.» The judge declared that this was not only against the clauses named, but, surpassing police regulation, was also «a bold and well contrived regulation of commerce, compelling the coveted trade to flow into the channel, and leave the tribute in the coffers of this private monopoly,» and as such was in violation with both the provision in the Federal Constitution giving Congress the sole power to regulate commerce, and the act of Congress under which the State of Louisiana was admitted into the Union.

This decision, with others, some varying, which had been given in different District Courts, were the next year, 1870, carried into the Supreme Court of the State, and there the case was determined in favor of the defendant corporation, and all persons enjoined from interfering with the privileges granted to it under its charter. The opponents of the company then took the case into the United States Circuit Court, asking for a perpetual restraining injunction against it. This was granted on the sole ground that the act incorporating the company was in violation of the 14th Amendment of the Federal Constitution, the court disclaiming jurisdiction over any other of the issues raised. A writ of error was asked for and obtained, and on it the case was carried to the United States Supreme Court. Here, after being three times argued, a decision was delivered in 1873, recognizing the validity of the act and permitting the exercise of the powers conferred by it. The decision of the court on the various issues involved gave the case its great importance. It had been contended, in the first place, that the act was invalid because it created a monopoly, conferring privileges on a few persons to the exclusion of all others, and depriving a numerous class of citizens of the right to follow their usual employment. On this point the court decided that the act was within the police power of the legislature — «a power incapable of any very exact definition or limitation.» From the decision upon this point a minority composed of the chief justice and two associate justices dissented. The objection had been urged by the complainants that the act was a violation (1) of the 13th Amendment of the Federal Constitution, by creating a kind of involuntary servitude; and (2) of the 14th Amendment, because it abridged the privileges and immunities of citizens of the United States, deprived the plaintiffs of their property without due process of law and denied them equal protection under the law. The court held that the term «servitude» in the 13th Amendment means personal servitude and that the purpose of the amendment was to guard against a continuance of slavery in any form, and that the amendment had not been violated by the act under discussion. As regarded the 14th Amendment the court perceived and established the difference between a citizen of the United States and a citizen of a State; it defined the rights and privileges of these two classes of citizens and held that only a citizen of the United States was placed under the protection of the Constitution by the clause in the 14th Amendment. The court further held that no other clause of the amendment was violated, the act of the legislature of Louisiana not being a deprivation of property, nor a denial of the equal protection of the laws, within the meaning of the amendment.

The minority of the court held (1) that the act of the legislature was of itself a step beyond the police powers of the State, and, therefore, was void; (2) that the act was also void under the 14th Amendment since it is in the meaning of that amendment that all acts of a State legislature shall respect the equality of rights of its citizens to follow the ordinary pursuits of life which equality of rights, the minority held, had been contravened.

The decisions of this case are considered extremely important because they not only discuss the police powers of the States, but because of the interpretations of the clauses in the Federal Constitution brought into issue. The case is reported in 16 Wall. 36, Supreme Court reports.

SLAVE COAST, Africa, a name formerly and still sometimes applied to a part of the coast of the Gulf of Guinea, from the mouth of the Niger westward to the river Volta. It is the coast of Togo, Dahomey and part of Nigeria. It received its name from the fact that its ports were the chief centres for the exportation of slaves.

SLAVE LAKE, Great. See GREAT SLAVE LAKE.

SLAVE LAKE, Little (or Lesser), Alberta, Canada, a lake in Athabasca Territory, about 270 miles southwest of Lake Athabasca. It is drained by the Lesser Slave River into the Athabasca or Elk River. It is about 60 miles long and its greatest breadth is about 12 miles. The surface of the lake is 1,890 feet above sea-level.

SLAVERY, an institution, state or condition by which certain persons (slaves) are held as the property of other persons (slaveholders); also the condition of a human being who is held as the property or chattel of another, who is absolute master of his body and service, subjecting him wholly to his will and domination. The system is one of great antiquity and was early practised among the Hebrews. It existed among the Assyrians from the earliest recorded times, among the Babylonians, Chinese, Egyptians and all the ancient peoples. The primitive religions appear to have all sanctioned the institution. Slaves were obtained by capture, purchase and by breeding. They were often controlled by whipping, branding and were at times subject to cruel punishments and death at the whim of their masters. The females were used without their consent, and beautiful girls and women were sold often at public auction. The slaves of the ancient Romans were either captives or debtors who were unable to pay. In Rome the slave had originally no rights. He could be put to death for the smallest misdemeanor. Slaves were exceedingly numerous, and latterly almost monopolized all the various handicrafts and occupations, those of the clerk, the doctor and the literary man included. In the time of Augustus a single person is said to have left at his death over 4,000 slaves. Hosts of slaves were employed in the gladiatorial exhibitions. Slave revolts occurred in 134 and 102 B.C. in Sicily, and a revolt in Italy led by the gladiator Spartacus in 73 B.C. was put down with considerable difficulty. Slaves, however, were often set at liberty, and these freedmen were a well-known class in Rome. But it was not until the time of the empire that any great change took place in the condition of the slaves. Augustus granted the slave a legal status, and Antoninus took away from the masters the power of life and death over their slaves.

The early Christian Church did nothing to suppress slavery, and slavery and the slave-trade continued to exist for 1,000 years in the Christian nations of Europe that arose on the ruins of the Roman Empire. It was not until the 13th century that the severity of slavery began to decline in Europe. The Koran expressly permits the Moslems to acquire slaves by conquest, but this method of acquiring slaves was not resorted to until the Crusades. Previous to the Crusades they kept negro slaves imported from Africa. Latterly the Mohammedans began to obtain white slaves not only by war but also by purchase, Rome being the centre of the trade. The Mohammedans of the Barbary states also obtained white slaves by piracy in the Mediterranean. The superiority of the white races in war, and the comparative helplessness of African blacks, led to the common practice of invading African coasts and capturing men and women during the 16th, 17th and 18th centuries.

After slavery had become largely reduced in Europe, it had a new birth in the American colonies of European origin. The Portuguese were the first to hunt negroes in the interior of Africa for use as slaves in the colonies. The first shipment of negroes to the New World took place in 1503, when the Portuguese landed some in Santo Domingo. The first shipload of slaves to the United States was landed at Jamestown, Va., in 1619. From that time to the 19th century a traffic in negroes across the Atlantic was carried on by all the Christian colonial powers. Slavery in the British possessions was abolished in 1838, £20,000,000 sterling being paid in compensation to the slaveholders; but it was not abolished in her West Indian colonies until 1839, and in India in 1843. Sweden abolished in 1846, France in 1848, Holland in 1859, Brazil in 1871, Porto Rico in 1873 and Cuba in 1880; African protectorates in 1897 and 1901, the Philippines in 1902. Mohammedan countries and Portuguese dependencies still cling to the institution in 1918.

Slavery must be accepted as one of the stages in the evolution of man toward a recognition of universal freedom. Early man was wholly selfish and sought to dominate. When a war of conquest was undertaken, the scarcity of valuable goods obtained was compensated for by making slaves and menial workers of the men and household drudges and mistresses of the women. It was a phase of the rule of might, but the institution carried with it the seeds of destruction for the conquerors. The morality of the slave-owners and their sons was undermined and destroyed by the possession of female slaves, and the position of a wife in the family was lowered and debased by the contamination of the domestic circle. A considerable progress in slavery in time ruined a nation, as ancient Rome. Not only was degeneracy encouraged among the masters, but in case of a foreign war dissatisfied slaves at home were a serious menace. But as the majority of human beings have a kind side to their natures, so very many slave masters were generous and liberal in their treatment of their slaves, not only caring for their general prosperity, but arranging their marriages, and assisting their religious worship, permitting them to accumulate private funds, often to buy their own freedom. The Athenians had their publicly owned slaves as well as privately owned, the state often owning those who served public officials or who worked in the temples. In warfare the slaves were used as armor-bearers, workmen, galley-slaves, cooks and sometimes as archers and spearmen. The latter for specially meritorious service in war usually earned their freedom.

There were laws in both Greece and Rome for the protection of the slave, these being gradually developed toward the humane and liberal. In Athens an abused slave could demand to be sold, and he could not be killed at the whim of his master, even if he slew one of the master's family, but had to be tried by a court. Plato condemned slavery altogether, but Aristotle and other ancient savants approved it, believing it beneficial and necessary. In the time of Demosthenes, that orator was moved to speak of the general good treatment of the slaves, and to urge that their enemies would laugh if they knew how happy was the lot of a Grecian slave. While the slaves of Rome did gradually improve their condition and receive better treatment as the centuries rolled on, yet legal measures for their good treatment went much slower than in Greece. The law originally gave the master power of life and death over the slave; he was denied the right to marry. A slave could be examined as a witness only by the torture, because it was held that he would surely lie if not tortured. In Rome many slaves were chained at night, and galley-slaves were nearly always chained to their work. They were sometimes driven under the lash to heavy work, as in the mines and fields/ In the later history of Rome, however, the slaves fared better, and very many were placed in conditions that enabled them to earn their freedom. Some masters sought a safe guardian for their children by promising a slave liberty when they were grown. Other masters found that it was financially profitable to encourage their slaves to buy their freedom, since they became industrious and earned so much that by the time their freedom was purchased the master had more than enough money from them to buy another and probably younger slave. In the 2d century the Roman law forbade making eunuchs of slaves, stopped the sale of children into slavery and forbade taking an insolvent debtor as a slave. Under Hadrian the master's power to kill his slave was revoked. Later, under certain conditions the law allowed a slave to bring an action against his master. Justinian punished the rape of a slave as of a free maiden, but he saw no reason for stopping gladiatorial combats between slaves and wild beasts. During the centuries following the fall of Rome the slavery system of Europe gradually merged into serfdom. See UNITED STATES, SLAVERY IN THE.

SLAVERY IN THE UNITED STATES. See UNITED STATES, SLAVERY IN THE.

SLAVIC LANGUAGES. The Slavic languages form a separate group of the Indo-European languages and are more nearly related to the Lettish, Lithuanian and Prussian, with which they are frequently mentioned as the Balto-Slavic languages. Their original habitat before the period of migration in the 4th century and the original tongue from which they have sprung are still a subject of speculation. The origin of the word «Slav» which first makes its appearance among Syrian and Byzantine writers some time before the 9th century is equally undetermined. It certainly is not to be derived from *slava,* «fame» nor from *slovo,* «word,» as assumed by some Slavic scholars, but must, with greater probability, be connected with the Low Latin *sclavus,* «slave,» since Spanish Goths and Arabs received the great bulk of their slaves and eunuchs from Russia, and «eunuch» is in Late Greek *Kolobos, asklabos.*

The first Slavic tongue to be fixed by writing was the one adopted in the 9th century by the proto-apostles Cyril and Methodius, of the neighborhood of Saloniki, in their missionary work in Pannonia and Moravia, but it is still an unsettled question whether this original speech was Bulgarian or of the Moravian variety, hence the multiplicity of names for it, such as «Old Bulgarian, Old Slovenian, Pannonian.» From the fact that it became the liturgical language for all those Slavs who received their Christianity from Constantinople it is also called «Church Slavic.» It contains a considerable number of Germanic words and an exceedingly large number of Greek words in its vocabulary, especially such as refer to religious matters. In grammatical structure it is more primitive than any other Slavic language preserved to us, for it has an aorist in the verb and a dual both in the noun and the verb, and the earliest documents which have come down to us show unmistakablv the presence of nasal sounds, now quite lost in all but the Polish and an occasional Bulgarian dialect. On account of these ancient characteristics, Church Slavic is put at the basis of Slavic philology, but it would be a mistake to assume that this Church Slavic is the primitive tongue from which the other Slavic languages are derived. (For the further history of Church Slavic see RUSSIAN LANGUAGE).

The Russian literary tongue contains a greater proportion of Church Slavic elements than any other related language, which is the result of the important part the Church Slavic played in Russia as a means for literary expression. The history of the Russian language in modern times is treated separately, but here must be mentioned the fate of the Ruthenian or Little Russian, especially since through the separation of the Ukraine it is likely to gain new importance. It is a distinct group of the Russian dialects, which in the 18th century received literary polish under Kotlyarevski, and since produced the great poet Shevchenko and the storywriter Kvitka-Ovsyanenko. In the 19th century its literary activity was carried away from the Ukraine, where it had its origin, to Galicia, where at the universities of Lemberg and Czernowitz it was permitted to develop freely. But here it fell under German and Polish influence and almost led to the formation of a separate language, inaccessible to the Ukranians, who drew similarly upon the Russian dictionary for its new formations. The Ruthenian papers in the United States, nearly all of them of Ukranian origin, write in a curious mixture of Great and Little Russian. Now the formation of the Ukraine may change the aspect of the literary Ruthenian once more. The modern Bulgarian is phonetically very close to the Church Slavic, but grammatically it has departed from it more than any other Slavic language. It has lost practically all declensional forms and thus stands to the others in very much the same relation that English bears to the other Germanic tongues. The oldest document of the Bulgarian vernacular does not go beyond the 14th century, but it was only in the forties of last century that the first grammar of the spoken tongue was written down by an American, Elias Riggs, after which it was used, at first almost exclusively by American missionaries, in the translation of textbooks. Since then it has fallen, for its vocabulary and style, under the influence of the Russian literature.

The Serbo-Croatian language consists of three dialect groups which are distinguished by the word used for «what?» which is respectively *shto, cha* and *kay*. The first, considered to be the most elegant, is found in Serbia, Bosnia, Herzegovina and the Litoral; the second is spoken in northern Dalmatia, on the islands, in Sofia and the adjoining territory of Croatia; while the third is the vernacular of northwestern Croatia. The Greek Catholic Serbians used in the Middle Ages the Church Slavic for literary purposes, but this Church Slavic was permeated by Serbian exactly as it was Russianized in Russia. Only at the end of the 15th century was the spoken dialect of Ragusa and the Litoral used for literary works, and under the influence of the Italian it reached in the 16th century its highest development and that period is known as the golden age of Serbo-Croatian literature. In the 16th and 17th centuries, the *kay* dialect of Croatia gained predominance. The literary form of the language remained unsettled until the thirties of the 19th century, when Gaj put the *shto* dialect of Ragusa at the base of his diction and called it Illyric, in order not to offend any one by the choice of a local name. Meanwhile the Serbian, Vuk Karadzich, had been using the spoken Serbian in his writings. At the present time the Serbo-Croatian is divided into the Croatian of the Roman Catholics, written with Latin characters, and the Serbian of the Greek Catholics, written in a variety of the Russian alphabet. The two literary norms differ in a number of dialectic varieties, but there has been a tendency to bring the two together, at least the Serbian schoolbooks print about one-fourth of Croatian matter, and the Croatians give a similar amount to stories of Serbian authors. The Slovenians of Styria, Carinthia, Carniola and northern Istria, nearly all of them Protestants, have since the 17th century used their variety of the Serbo-Croatian as a separate literary language, and developed a beautiful literary norm, especially in the 19th century under the poet Preshern, out of a dialect of southern Carniola.

Bohemia began to use the spoken language for literary purposes as early as the 12th century, and in the 14th century no other Slavic language could vie with it in wealth of expression. John Hus employed it in his theological discussions, and under the influence of the German church poetry a vast number of hymns were written in Bohemian, especially by the Moravian Brethern. There was also a considerable activity in the poetry of the romantic type, in which it also followed German models. Beginning with the 17th century Bohemian fell into desuetude, but, this time again under the influence of German romanticism, Dobrovsky, the father of Slavic philology, in the beginning of the 19th century resuscitated the older language of the Moravian Brethren and since then it has been used for all literary purposes. Unfortunately Bohemian is in poetry handicapped by its accentuation, because, no matter how long a word may be, its accent, as in the unrelated Hungarian, is always on the first syllable, whereas in Russian, Bulgarian and Serbian it is mobile, but in Serbian there are really four melodic accents, which make the language very harmonious and musical.

In the 19th century the Bohemian dialect of the Slovaks in northern Hungary, for which it is claimed that it is a transitional language between Bohemian and Serbian, evolved a separate literature. The writer was fortunate in procuring in 1901 almost a complete set of this rare and quaint literature, amounting to something like 1,800 numbers, for the Harvard Library.

Slovenian and Slovak appeal to a population of less than 2,000,000 each, which makes their existence precarious. There is, however, another Slavic language, called by the Germans Wendish, and in philology Serbo-Lusatian, spoken in Lusatia by but a few hundred thousand people and yet divided into two distinct literatures differing somewhat in their literary norms, that of the Catholics of upper Lusatia and of the Protestants of lower Lusatia. After the Russian, the Polish is the best-developed literary language of the Slavs. It made its appearance in the 14th century, when it fell under Bohemian influence. Like the Bohemian, and unlike the other Slavic languages, Polish appears fixed in form from the beginning. In its vocalism it resembles French on account of its nasal sounds, and Italian on account of its soft consonantal utterance. Many of the consonants have four shades, which demand the addition of two diacritical marks and the use of *z* in connection with the Latin alphabet employed by it. The accent is nearly always on the penult, as in Italian. At first the literary form fell under the influence of French and Italian humanism, which led to the introduction of a very large Latin vocabulary, while the proximity to Germany led to the popular adoption of an exceedingly large number of German words. Polish literature had its golden age in the 17th century but it is only in the 19th century that it developed a rich literature, especially in poetry, that is comparable with those of the other nations of Europe. The closely allied Kashubian, Slovinzian and Polabian languages of East Prussia and Pomerania have been studied philologically, but they have not risen to literary forms. See articles on the languages of this group — Polish, Russian, etc.

Bibliography.— The leading philological periodical for the study of the Slavic languages in general is Jagić's *Archiv für slavische Philologie,* and of late the whole subject of Slavic philology has been treated in the still unfinished work on Slavic philology by Jagić in the Russian language. The 'Comparative Dictionary of the Slavic Languages' by Miklosich is not satisfactory, and his large 'Comparative Grammar' is now superseded by Vondrák's work. For the study of Church Slavic we fall back on Leskien and Vondrák, but the historical evolution of Church Slavic still needs an investigation. A large number of Russian monographs deals with various aspects of the Russian dialects. The best dictionaries are those of the Academy, barely begun, and Dal's great 'Dialect Dictionary.' The White Russian has been studied by Karski, and we have for it a good dictionary by Nosovich. The Little Russian has been similarly studied by Potebnya and Ogonovski, and a large number of other authors. The Bulgarian dialects have been lavishly investigated in a government publication of bulky proportions, especially by Miletich and Tsonev, and the Serbo-Croatian language has since the days of the founder of the science, Vuk Karadzić, been elaborately treated by native and foreign scholars, and of late a Croatian dictionary on a truly grand scale has been published by Broz-Iveković. The most accessible dictionary for foreigners is the 'Croatian-German and German-Croatian Dictionary' by Filipović. Similar studies exist for the Slovenian and Janezić's 'Slovenian-German and German-Slovenian Dictionary' will be found very useful for the student. Bohemian was early treated by Dobrovsky. Since then there has appeared the excellent historical grammar by Gebauer and his unfortunately unfinished 'Old-Bohemian Dictionary.' The most useful dictionary for the foreigner is Jungmann's. The Slovak has not yet enjoyed a careful study, but the Lower Lusatian has both an excellent grammar and dictionary by Mucke, while both dialects are accessible in the similar works by Pfuhl. Even the Kashubian, Slovinzian and Polabian have found careful investigators in Lorentz, Schleicher, Mucke, Mikkola and others. A monumental 'Polish-German Dictionary,' by Linde, appeared in the beginning of the 19th century before Grimm had planned his German Dictionary. Within the last few years a still larger dictionary of the literary language and a great dialect dictionary has been published by the Cracow Academy of Sciences. The best historical grammar is that by Kryński.

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SLAVIC MYTHOLOGY. Of Slavic mythology we cannot obtain a distinct picture, owing to very defective traditions among the peoples of Slav race and perhaps still more because of a great scarcity of records. The early history of this whole race is, in fact, shrouded in darkness, and we do not even definitely know the time of the first arrival of Slavic tribes in Europe. We do know, it is true, that some of them were heard of as early as the 1st or 2d century of the Christian era, but of their manners and customs, their vernacular and, above all, their creed and worship we know next to nothing at that early time. In some regions of Europe they appear to have preceded the Teutons and to have taken possession of the land, while in others they followed Teutonic tribes, such as the Marcomanni in what is now Bohemia, the Vandals on the Baltic, the Goths and Gepidæ after these had started off on their conquering migrations toward the West and South which were at last to end in the destruction of the Roman Empire. So far as indications go, the bulk of the progenitors of the Slavic populations of to-day seem to have reached and in a manner settled on European soil by the 5th and 6th centuries of our era. But in their shifting occupation of districts and lands, but vague recollections of the mythology of their race have remained. Of the Southern Slavs (Serbians, Bulgarians, Croatians), the Poles and the Czechs we do not even possess the names of their early gods. Generally speaking, the Slavic creed consisted in a worship of the forces of nature. We find dim reminiscences of a "heaven-god," Svarog (the Vedic Varuna), who apparently was acknowledged more or less by all Slavs. We encounter in the scant records a solar deity, Dazhbog, paid honors to by other tribes under the name of Khors. Fire was worshipped as Ogon (Vedic Agni) and the wind-god as Stribog. With the Northeastern Slavs the chief deity was Perūn, the god of thunder and lightning, the Vedic Parjayna, the Teutonic Donar or Thor. The Western Slavs again along the Baltic coast, such as the Obotriti, the Vinds or Wends, etc., paid homage to a god Radegast or Radegost, also named Sviatovit or Svantevit, the three-headed and trebly-gifted god Triglaff, of whose images and devotional service detailed descriptions have been given by ancient writers. These Western Slavs, too, had temples and sacrificial altars, as well as priests, but this does not seem to have been the case with the Slavs of the East. Of inferior gods, on the other hand, or semi-divine beings there still linger memories among all Slavs, such as of the Rusalkas and Vilas (Volos, Veles), wood nymphs and spirits haunting the forests, springs, pastures and lakes, of Kupalo and Garilo, fertilizers of the earth, representatives of the summer sun. The Western Slavs first accepted Christianity through the Greek monks Cyril and Methodius. Some writers tell of a species of dualism, of a ceaseless struggle between darkness and light, in which the Slavs put faith. But this legend seems to have been more owing to Christian influences. Of the "white" and "black" god, Bjelbog and Czernebog, said to have been believed in by the Slavs inhabiting the tract between Oder and Elbe, we know nothing reliable. But that nearly all Slavs put faith in the field and house spirits, including also the Royeniczas and Soyeniczas (goddesses of birth and fate), the Domowyje and Leshiye, the Babayaga of the Russian, is attested sufficiently.

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SLAVONIA, a former territory of Austria-Hungary which, with Croatia, constituted the provinces of Croatia and Slavonia, forming part of the possessions of the Hungarian crown. It is bounded on the northeast by Hungary, on the south by Bosnia and part of Serbia and on the west by Croatia and has an area of 3,640 square miles, exclusive of that portion of the military frontier lying between Slavonia and Croatia, which may be regarded as falling within its limits. A branch of the Carniolan Alps, entering Slavonia from Croatia on the west, traverses it throughout its whole length, forming the watershed between the Drave on the north and the Save to the south. The forests are very rich and cover the upper mountain sides on whose lower slopes cultivation is actively carried on. The valleys are extremely fertile; but there are large swamps created by the frequent inundations of the river, rendering the climate in parts extremely unhealthy. Agriculture is the most important occupation, the principal products being grain, fruit, flax, hemp and wine, and the leading exports, grain, wine, fruit, cattle, lumber and the celebrated *Slivovitz* brandy, distilled from plums. The inhabitants are chiefly Serbs and profess for the greater part the Roman Catholic and the Greek Orthodox faith. The chief town is Eszek. With Croatia it had a national Landtag or Diet and sent representatives to the Hungarian Parliament. The population of Croatia and Slavonia is about 2,600,000.

As part of Illyricum, Slavonia was acquired by the Romans in the reign of Augustus and was incorporated with the province of Pannonia. From the Byzantines it was wrested in the 5th and 6th centuries by the invading Slavic tribes, from which time dates its close union with the country to the west which came to be known as Croatia. The united state was ruled by princes of the Hungarian royal house till the early part of the 16th century, when Slavonia was overrun by the Turks. They were driven out at the end of the following century and the territory was organized on a military basis for the defense of the Austrian frontier. Part of Slavonia was placed under civil administration in 1745, but the military frontier was not done away with until 1873. The two provinces had autonomy for home affairs, public instruction and justice. At the Jugoslav Convention held in Geneva in November 1918 a national government representing all Jugoslav provinces was constituted and Slavonia became a part of the new state. See Jugoslavia; Austria-Hungary; Croatia-Slavonia.

SLAVONIC ENOCH. See Enoch, Books of.

SLAVS, slavz, the general designation for a group of peoples inhabiting eastern and central Europe and forming one of the most important branches of the Indo-European family of nations. The name is derived from the native term *Slovenia,* the origin of which is obscure, some connecting is with *slovo,* word, speech, and others with *slava,* glory. In support of the former etymology is the fact that the Slavic term for foreigner is *nientsy,* dumb, marking the differentiation between those whose speech was intelligible to the Slav ear, that is, the Slavs themselves, and those who made use of an incomprehensible tongue. The connection between Slav and slave, though supported by the analogy of *servus* and Serb, is nevertheless merely fanciful. The Slavic group comprises the following nationalities: Russians (including the Great Russians, the Little Russians, or Ruthenians, and the White Russians), Bulgarians, Serbo-Croatians, Slovenians, Czechs (comprising the Bohemians, the Moravians and the Slovaks), Wends or Sorbs (consisting of the inhabitants of Upper and Lower Lusatia, and Poles with the allied Kashubes). The Polabians, a Slavic people formerly living on the Elbe, have been extinct since the middle of the 18th century. The early history of the Slavs is veiled in obscurity, and only an approximate idea as to their original home is to be obtained. In Pliny and Tacitus the name Venedæ (whence the modern Wenden) appears as the designation of a group of non-Germanic tribes living to the northeast of the Carpathian Mountains and extending to the shores of the Baltic and the lake country of the Finns. Ptolemy in the 2d century of our era gives a description of the peoples residing between the Vistula and the Don which would undoubtedly tend to connect a part at least of these tribes with the Slav family. Roughly the home of the Slavs in the first centuries of the Christian era may be given as extending from the Vistula and the Carpathians northeastward to the headwaters of the Volga and along that stream to its junction with the Oka, and southeastward to the Bug and Dnieper, comprising thus the southwestern third of the present Russia. South and southeast of the Baltic, however, were the Lithaunians, a non-Slavic people, though nearest to the Slavs of all Indo-European stocks. In the 6th century Procopius and Jardanes speak of two great Slavic nations, the Sclaveni and the Antes, as established on the left bank of the Danube and to the north. From this it would seem that in the 3d or 4th century the Slav peoples began to migrate from their homes southward, and westward, under pressure probably of the Baltic tribes to the north. In the 5th century they took possession of the country between the Vistula and the Elbe, left unoccupied by the southward migration of the Germanic Burgundians, Goths, Suevi, etc. Slav tribes entered Bohemia and Moravia about the same time, while others advanced from beyond the Carpathians and made themselves masters of western Hungary, whence they passed into Styria, Carinthia and Carniola. At the beginning of the 7th century the Slavs on the Danube crossed into Mœsia and overran Thracia and Macedonia. At the same time Serbs and Croats made their homes in the ancient Illyricum and Dalmatia. A second great wave of Slav migration, starting from the original home north of the Carpathians, spread east and north, pushing the Finns before them. Under Scandinavian rulers these tribes became the nucleus of the Russian nation. Of this wide area of conquest they have lost in the process of time the regions of the Oder and the Elbe, Upper Austria and part of Carinthia and Styria, of all of which they were deprived by the Germans; large parts of Transylvania and Hungary which fell to Rumanians and Magyars; and parts of the regions south of the Danube which later passed to the Greeks and the Turks.

The ancient Slavs were almost exclusively an agricultural people, averse to all war, and living in complete tribal independence under a fully developed patriarchal system which at a later time became blended with a communal form of government. They were the latest of all the European peoples to enter the sphere of modern civilization, their religion and their literature being, as compared with the other nations, of recent date. The eastern branch of the Slavs received its civilization and religion from Byzantium, the western Slavs from Rome. Christianity made rapid headway among them in spite of the fact that they seem to have possessed a well developed nature-cult about which, however, we possess no definite information. Our materials are limited to the names of various deities worshipped among the northern Slavs, while as to the mythology of the southern branches of the race even such data is wanting. Among the gods of the Russian Slavs were Pernu, identified by some with Thór, the northern god of Thunder, Dazbig (the day god), Wolos, Stribog and others. Svintovint or Sviatovit was the great god of the Baltic Slavs (Rügen), and some who maintain that along with their idol-worship the Slavs possessed a belief in a supreme God would assign to Svintovint that rôle. Grimm erects Svintovint, Pernu and a god named Radegast into a trinity with functions corresponding to the classic Jupiter, Vulcan and Mercury respectively. Other deities worshipped by the Slavs were Prava, the god of justice; Rugevit, of war; Triglaw; Lado and Lada, divinities of order and love; Dievana (Diana), goddess of the woods, and Prija, the Scandinavian Freya. Among the Silesian Slavs the principles of light and darkness were typified by the Bielobog and the Chornobog, the white god and the black god. The mythology of the Slavs was rich in deities of a lower order, in nymphs, naiads and mountain sprites, in goddesses of birth and fate, divinities of the hearth and the field, in evil demons and vampires. The forms of the Slavonic deities recall to mind those of India. Svintovint was represented as four-headed, Pernu as four-faced, etc. There is some testimony to a belief entertained by some of the Slavs in the immortality of the soul and a resurrection beyond the grave. Their principal celebrations were the *kobiada*, a feast held at the beginning of the year, when an interchange of presents was customary; the *kupalo*, a feast that took place in honor of the sun at the time of the summer solstice; and the *trizna*, celebrated in honor of the dead. The functions of priest and ruler were combined in the same person.

From available data it is quite a hopeless task to fix, with any degree of certainty, the number of Slavs in Europe. Official statistics — where issued — are not always reliable, and independent authorities differ widely, even on the question of how many Slav languages there are. It was not until the first quarter of the 19th century that any serious attempt was made to estimate the Slav populations. Schaffarik in 1826 arrived at a total of 55,270,000; in 1842 he made it 78,000,000; basing his calculations on these figures and those of the Russian historian Pypine, Prof. Louis Leger of the Institut de France struck a total of 79,550,000 in 1868. Zarianko's Russian geography (1891) gave a total of 101,724,000, while Schrader's atlas showed only 97,000,000. M. Niederle. a Bohemian authority, estimated 139,000,000 in 1900, and reduced it to 138,500,000 in 1905. In 1907 a distinguished Russian scholar, M. Florinsky, arrived at 147,146,000 and calculated that, the annual birthrate of the Slav race being 1.7 per cent, it would increase by 2,500,000 per year and would in consequence number 186,000,000 in 1915 and 200,000,000 in 1920. Taking such figures as are available, according — in each case — to the last census, we find the Slav population of Russia given as 92,089,733; Austria, 16,959,095; Hungary, 5,380,190; Serbia (subjects only) 2,890,602; Bulgaria, 3, 203, 810; Montenegro about 500,000: a grand total of 121,023,430. Most of these statistics, however, were compiled in 1910 and do not include the German Poles nor the other Slavs residing in Germany, Rumania, Turkey, Great Britain, etc. Only one census has been taken in Russia — in 1897. During 1913 and 1914 there were 1,079,677 emigrants to the United States from countries in Europe having predominant Slav populations, mainly Russia and Austria-Hungary, while between 1911 and 1915 Canada received 144,792 from those countries, and numbers also went to South America In the United States alone there are nearly 4,000,000 Poles, over 2,000,000 Czechs and Slovaks, and some 2,000,000 Jugo or Southern Slavs, besides Russians, Serbs, etc. The European War and the Balkan wars of 1912–13 exacted a heavy toll of Slav blood. The great losses of Russia on the battlefields and in the anarchy following the revolution; the casualties among the Slavs of the ill-fated Austro-Hungarian armies; and the practical extermination of Serbia, besides Bulgarian and Montenegrin losses, must inevitably exert a seriously weakening influence upon the Slav race and disturb the value of statistics. These factors should be borne in mind with regard to the following table, collected in 1918:

Russians	100,000,000
Little Russians	30,000,000
Poles	20,000,000
Czechs and Slovaks	10,000,000
Slovenes	1,300,000
Croats	2,500,000
Serbs	4,000,000
Bulgars	4,500,000
Total	172,300,000

Languages.— The Slavic tongues have been the subject of much controversy and varied classification. On this point, as on that of vital statistics, several authorities — themselves Slavs — differ. Josef Dobrovsky, a learned Czech (d. 1829), counted nine living languages and as many Slav nations in 1822; Schaffarik in 1842 found six languages and 13 dialects; Sreznevsky in 1843 discovered nine and Schleicher in 1865 counted eight. Jagitch made it eight in 1898, while Miklositch and Florinsky (the latter in 1907) came back to nine. According to more recent research, however, considering the numerous separatist tendencies, the number of Slavic languages has been raised from 11 to 14, without reckoning those which are extinct. According to Niederle there are (1) the Russian group, regarded as two nations, the Great Russians and the Little Russians, the latter including the southern Russians, Ukrainians and Ruthenes; (2) the Polish group; (3) the Lusatian-Serb group, divided into High and Low Lusatian; (4) the Czech group in Bohemia and Moravia, from which the Slovaks of Hungary are more or less divided according to political views; (5) the Slovene group, without separatist tendencies; (6) the Serbo-Croatic group, representing Serbs and Croats; and (7) the solid Bulgarian group, homogeneous except for the Macedonian Slavs, of which some lean to the Bulgarians, some to the Serbs, and others who, until 1913, claimed a separate or Macedonian nationality. Another method of grouping is as follows: (1) Bulgarian; (2) Serbo-Croatic; (3) Slovenian (2 and 3 sometimes being given as one group); (4) Russian, including Great Russian, Little Russian and White Russian; (5) Czechish with the closely related Slovak; (6) Sorb or Wendish; and (7) Polish, Bulgarian, Serbo-Croatian and Russian have sometimes been classified into a Southeastern Slav group as against a Western group consisting of all the others. To the latter group should be added the extinct Polabian. The oldest of the Slavic tongues is the old Church Slavic or Old Bulgarian, which is still the ritual language of the Greek Orthodox Church in Russia, Bulgaria and Serbia. The Slavic languages are marked by a richness of vowel sounds and sibilants and a high degree of inflection, which in the noun possesses seven cases, and in the verb, in spite of a restricted number of tenses, a large number of modal and effective auxiliaries rendering possible the finest distinctions of meaning. The so-called Cyrillic alphabet is used in the Russian, Bulgarian and Serbian, but the Old Church Slavic makes use also of the Glagolitic alphabet (q.v.). The Polish, Croatian, Czech, Slovenian and Sorb employ the Roman characters.

Slavic Music.— Sentiment, which forms so prominent a trait in the Slav character, renders the members of that race peculiarly subject to the influence of music. In Russia the origins are found in the folk-songs which were greatly influenced by the music of the Church. In the 17th century western influences entered the country and especially the Italian, which lasted well into the 19th century, when we have the use of a national school with the appearance of Glinka (q.v.). The prevailing characteristic of Russian music, whether classic or popular, is an all pervading tone of melancholy which has found its fullest expression, perhaps, in the works of Tschaikowsky. Polish music, in many respects resembling the Russian, differs from the latter in a greater vivacity of movement and spirit. The Bohemian is the third important national school of Slavic music and one which in recent years has surpassed the Polish in productivity and held its own with the Russian. For the leading names in Russian music see in addition to those already mentioned, Dargomyzshky; Balakirev; Borodin; Rimsky-Korsokoff; Rubinstein; Arenski; Taneyeff. For Poland see Chopin; Moszkowski; Paderewski. For Bohemia see Smetana; Dvořák.

Panslavism.— This name was originally given to the agitation carried on by a great party in Russia with the object of uniting the Slav peoples of Europe under Russian rule or influence. The movement originated about 1830, when the Polish revolution aroused Slavic national consciousness; it received increased strength from the second Polish revolt in 1863. Congresses of Slav representatives from the different European countries were held at Prague in 1848 and Moscow in 1867. Outside of Russia the ideals of Panslavism were favorably received by the Slavs in Bohemia, Silesia and Croatia-Slavonia, where the members of that race felt their national existence threatened by the repressive policy of the government, Austrian, Hungarian or German as the case might be. Panslavism was largely responsible for the outbreak of the Russo-Turkish War of 1877–78, when Russia entered the lists as the champion of the Balkan Slavs who suffered under the tyranny of Turkish rule. Russia defeated the Turks with the assistance of Rumania (non-Slav); Bulgaria, Serbia and Montenegro, Slav nations. Though the Berlin Congress demolished the Treaty of San Stefano, the four nations were made practically independent of Turkey, and Russia became the recognized protector of the Balkan Slavs. It must be added, however, that this "big brotherly" policy was not unconnected with the old Russian ideal of paving the road to Constantinople. Moreover, this Balkan policy of Russia ran counter to the interests of the Austro-Hungarian monarchy, also a great Slav power. This antagonism rendered impossible any rapprochement between Russia and Germany, the latter being Austria's ally. In this may be recognized the seeds of the European War. Nothing short of an absolute renunciation by Russia of her Panslav policy in the Balkans could remove the possibility of an ultimate rupture with Austria. In course of time, Panslavism broke out in a direction that was perhaps not anticipated by Russia. As the Balkan states grew stronger under the stimulus of national consciousness, fostered by the creation of national armies and more or less democratic institutions, they gradually realized their ability to shape their own destinies. While fully willing to accept all the advantages which the protection of Russia offered, they were not prepared to fall under Russian dominion. Stambuloff, in Bulgaria, pursued a strong anti-Russian policy, and the Serbs cast longing eyes upon the vision of an independent Greater Serbia including the Austrian provinces of Bosnia-Herzegovina and their nationals in Macedonia — then still Turkish territory. Not improbably, they also counted on the inclusion of Croatia, Slavonia and the Dalmatian coast line after the long-prophesied break-up of the Austro-Hungarian empire. Bulgaria likewise had designs on Macedonia; Bohemia clamored for her ancient rights as a kingdom, and the Poles sought the restoration of their country, partitioned between Russia, Germany and Austria — an ambition at all times rigorously suppressed by those three powers. Russia stood to lose comparatively little by an all-round fulfilment of these national aspirations; to Austria-Hungary it meant a dissolution of the monarchy. Hence the general principle may be accepted that Austro-Russian rivalry, plus the conflicting aims of Austria and Serbia, provided fully one-half of the direct causes of the European War, and that Germany contributed the other moiety by utilizing this antagonism to further her own ambitions. The situation was thus summarized by President Wilson on 14 June 1917: "The war was begun by the military masters of Germany, who proved to be also the masters of Austria-Hungary. . . . The demands made by Austria upon Serbia were a mere single step in a plan which compassed Europe and Asia. . . . It contemplated binding together . . . Czechs, Magyars, Croats, Serbs, Rumanians . . . Bohemia . . . the stout little commonwealths of the Balkans. . . . These people do not wish to be united. . . . They ardently desired to direct their own affairs, would be satisfied only by undisputed independence."

By the summer of 1918 the Panslav movement had attained gigantic proportions. Though entirely diverted from its original aims of unification into a revolutionary scheme of independent separatism, based on nationality, no more appropriate title could be applied to it. A powerful impetus to the cause was the official sympathy extended to its representatives in France, America, Italy and Great Britain. On 22 Jan. 1917 President Wilson declared in favor of an autonomous Poland; the Czecho-Slovak and Jugo-Slav agitation in the Austrian Parliament spread throughout the monarchy and was enthusiastically supported by their nationals scattered throughout the allied countries. Already at the beginning of the war thousands of Austrian Slavs — whole regiments — had gone over to the Russians. Large numbers escaped from the country and joined the Allies in France and Italy. On 6 Jan. 1918 a congress of Czech deputies reasserted their claims at Prague; in April a similar gathering was held at Rome; disorders spread throughout Bohemia and other districts of the monarchy leading to a state of siege around Prague and the establishment of martial law among the Slovenes and Slovaks. On 4 May 1918 the Austrian Reichsrat was abruptly closed by the emperor. Anti-German demonstrations were severely suppressed and thousands interned. Barracks and public buildings were set on fire and German newspaper offices sacked. A Slovene regiment mutinied and killed its German officers. Czecho-Slovak regiments fought in the Italian army and in Russia against the Bolsheviki. In New York, Kossovo Day was commemorated on 16 June 1918, attended by thousands of American Slavs.

SLEEP, a state of rest for both body and mind, during which there is partial abeyance of volition and consciousness, with a relaxed condition of the body and a lessened activity of certain of the vital functions. The muscles do less work in the way of voluntary contractions, and there is, therefore, a diminution in this feature of their tonicity; the respirations are less frequent and rhythmical; occasionally there is a long expiratory pause; the output of carbon dioxide is diminished more than the consumption of oxygen; the pulse is less frequent; the secretions are partially suspended, and the pupils of the eyes are contracted. The whole body is in a state of increased vagus tonus, vagotonia.

Sleep is probably due to a rhythmical cycle habit of millions of years of evolution and is chiefly a tropism reaction to light and temperature impressions. It has been biologically developed by reason of its value as a resting period for less active energy transformation. All parts of the body require such rest as sleep affords, and share, directly or indirectly, in its benefits, for functional activity without periods of rest results in an undue destruction of the tissues and an excess of poisonous products. The essence of the sleep state is functional rest and nutritive repair. Though the brain is in repose, it nevertheless is in function during sleep just as much as all the rest of the body. This activity is registered in dream activity, some of which remain in consciousness. Generally, the more the body can be withdrawn from outside influences the more readily is refreshing sleep obtained. Sometimes pain assists to this end. For example, a man is worried with business cares and has not slept well of late. One evening he has a severe toothache which demands his entire attention. As the pain is relieved he drops off into a quiet sleep and forgets his troubles in unconsciousness.

The amount of sleep needed by different persons varies with age and condition. The greater part of infancy is generally passed in slumber, which is more profound than that of adults. In middle life from six to eight hours' sleep a day is necessary, though it is reported of Frederick the Great and Napoleon that they slept but three or four hours daily. Old persons frequently require seven or more hours' sleep, though some live healthfully with but six. Occupation, race, sex, climate and habit have to do with the amount of sleep required. Brain workers, as a class, take less sleep than laborers. Sleep is sounder and longer in cold climates and among northern races. Women usually take more sleep than men. The influence of habit is noticeable when the demand for sleep comes at a definite time, or in the case of those accustomed to sleep amid noisy surroundings, and who cannot readily sleep in a quiet resting-place.

The disorders of sleep may be classified as follows: (1) Absence of sleep — insomnia, vigilance; (2) imperfect or partial sleep — dreams, sleep-drunkenness, or somnolentia, night-terrors and nightmare; (3) perverted or artificial sleep — somnambulism, hypnotism, mesmerism, trance, somnium; (4) excessive or frequent drowsiness and sleep — morbid drowsiness or somnolence, paroxysmal sleep, epileptic sleeping attacks, trance-sleep, carus, cataphora, lethargy — sleeping-sickness of Africa.

The causes of disordered sleep are many, such as brain affections, blood-poisoning, pain, indigestible food, discomfort, produced by undue cold or heat, mental excitement or worry, overfatigue, febrile conditions, sleeping in an uneasy position or with the head too high or too low, too little outdoor exercise, sleeping amid unaccustomed surroundings. The treatment of disturbed sleep sometimes taxes the art of the physician. Mental repose, bodily comfort, a sufficient degree of warmth, a certain amount of fatigue, combined with perfect quietude, are essential. An evening walk, a cup of hot milk or cocoa, or a weak stimulant just before retiring, massage, counting and verbal repetitions are aids in producing sleep. Hypnotic medicines should be avoided if possible. Brisk exercise in the open air, every day if convenient, to the point of tiring, is a good sleep-producer. Consult Powell, L. P., 'Art of Natural Sleep' (New York 1908); Bruce, H. A., 'Sleep and Sleeplessness' (Boston 1915).

SLEEPER. A heavy timber laid horizontally at the base of a structure, specifically: (1) A cross-beam or tie supporting the rails of a railroad. (2) In shipbuilding, a heavy floor timber in a ship's bottom. (3) In carpentry and building, any heavy horizontal beam on a ground floor.

SLEEPER-SHARK. See SHARKS.

SLEEPING BEAUTY, The, a fairy tale, probably founded on nature's long sleep in winter. The Earth-goddess falls into a deep sleep, from which she is aroused by the prince, the Sun. We may compare Demeter's search for her lost daughter, Proserpine, in the Greek myth; and the sleep of Brynhild, stung to her sleep by the sleep-thorn. 'The Two Brothers,' found in an Egyptian papyrus of the 19th Dynasty — the time of Seti II — contains similar incidents. The spindle whose prick causes the long slumber is a counterpart of the arrow that wounds Achilles, the thorn that pricks Sigurd and the mistletoe fatal to Baldur. In 'Surya Bai' (from 'Old Deccan Days') the mischief is done by the poisoned nail of a demon. In the Greek myth of Orpheus, Eurydice is stung by the serpent. In a Transylvania variant a maiden spins her golden hair in a cavern, from which she is rescued by a man who undergoes an hour of torture for three nights. The awakening by a kiss corresponds to Sigurd's rousing Brynhild by his magic sword.

SLEEPING-SICKNESS, a peculiar disorder, also called sleeping-disease, African lethargy, lethargus, negro lethargy and nelavan, endemic, especially in western Africa. It is apparently infectious, occurs mainly among negroes and is said to be very fatal. Investigations by the English government and by the Liverpool school of tropical medicine show that its prevalence has been exaggerated by the natives, that it has been confounded with other prevailing diseases which have some of the same symptoms but are distinct affections. The natives in their dread of this malady are ready to assert that a person having enlarged glands, headache and a dry skin, and becoming thin and drowsy, has sleeping-sickness. That the disease prevails at times in certain localities, and is generally fatal, is not disputed, though continued and abnormal sleep has not been present in all cases. M. Christy, in July 1902 found an infected area in a strip of coast-line along the shore of Victoria Nyanza over 100 miles in length, and along the margins of all the islands in the British portion of the Victoria Nyanza. Cases of the disease discovered back of this area were infected, he believes, at the shore. Nearly all the cases of sleeping-sickness that he saw were in persons who had lived on low swampy ground or near the water-edge, in huts surrounded by banana-plants or forest growth. Compact villages on dry land with but little surrounding foliage were not seriously infected.

Various theories as to the cause of the disease have from time to time been broached. It has been supposed to be due to food-intoxication, like pellagra (q.v.), or caused by one of the many animal parasites common in Africa. Disorders of circulation, mental depression, bad and insufficient food, intestinal and blood parasites are predisposing causes. The recent investigations of Bruce, Castellani, Christy, Dutton, Forde and others show that sleeping-sickness is probably caused by a parasite, a species of trypanosoma, which is transmitted from the sick to the healthy by a variety of the tsetse-fly. This parasite enters the blood and the cerebro-spinal fluid, producing, what is called by the recent investigators, human trypanosomiasis, to distinguish it from the trypanosomiasis which affects horses, fish, etc. The species of tsetse-fly in question inhabits the places where sleeping-sickness is prevalent, and Sambon believes that this fly is not only a carrier of trypanosomes, but acts also as an intermediate host; and is troublesome to man at certain seasons.

Autopsy in cases of sleeping-sickness shows chronic meningitis, encephalitis, meningomyelitis and trypanosomes in the cerebro-spinal fluid and blood. The symptoms may be divided into three stages, one indefinite, one of tremor and a third stage of intense weakness. "True sleep is not really a symptom of the disease." There is at first a disinclination to work or move about. This is followed by headache, pains, especially in the chest, dullness, slowness in answering questions, mumbling and a shuffling gait. Then there are tremors of the tongue and hands; glands may be greatly enlarged (but gland-enlargement is common among the natives); the pulse varies from 90 to 130; evening temperature is from 100° to 102° F., with a morning fall of 1°. The patient becomes drowsy, lethargic and very thin and weak, and takes to bed; the temperature falls, coma appears and death occurs from convulsions or starvation. The disease usually lasts from four to eight months. The researches of Ehrlich and others have devised chemical drugs, usually containing arsenic, which have resulted in the killing of the parasite in the body and thus in curing this disease. Consult Stedman, 'Reference Handbook of Medical Sciences' (1917). See SALVARSAN.

SLEEPY HOLLOW, the valley of the Pocantico Creek, half a mile north of Tarrytown, Westchester County, N. Y. It is best known as the scene of Washington Irving's 'Legend of Sleepy Hollow,' in which he so vividly describes the quiet scenery of the valley and the quaint customs of the old Dutch settlers. The Dutch church, built in 1699, and the old mill conspicuous in the 'Legend' are both standing; and in the newer part of the churchyard cemetery is Washington Irving's grave. Near the mill is the old Philipse Mansion. Above the cemetery rises a knoll, which in 1779 was fortified by the Continentals, but was never attacked.

SLEET, snow or hail either mingled with a fine rain or in a partially melted condition before the surface of the earth is reached. Sleet may be produced by the simultaneous precipitation of snow or hail from a superior, and of rain from an inferior, stratum of the atmosphere. Its formation is usually due, however, to the partial melting of snow or hail in passage through an upper stratum of air above 32° F., and its subsequent refreezing upon traversing a lower stratum whose temperature is below the freezing point.

SLEIGH, a light vehicle on runners usually with shafts or pole for horses, designed for light loads or pleasure travel over frozen snow or ice, or over the bare ground. A heavy vehicle on runners is usually termed a sledge, as the stout traveling carriage mounted on runners, much used in Russia, Canada and other northern countries during winter, instead of wheel-carriages. A very small and light vehicle on runners for hand use is called a sled.

SLEMMER, slĕm'ėr, **Adam Jacoby,** American soldier: b. Montgomery County, Pa., 1828; d. Fort Laramie, Kan., 7 Oct. 1868. He was graduated at West Point in 1850, assigned to the artillery, fought in the campaign against the Seminole Indians in Florida, and in 1851–55 was engaged on frontier duty in California. He was assistant professor of geography and history in 1855 at West Point, and of mathematics in 1856–59. In 1860 he was ordered to Florida and was promoted major in 1861, served for a time as inspector-general of the Department of the Ohio, and in 1862 was attached to General Buell's army. He was appointed brigadier-general of volunteers in 1862 and at the battle of Stone River, 31 Dec. 1862, he was severely wounded, incapacitating him from further active service in the war. He was promoted lieutenant-colonel in 1864, and in 1865 was brevetted colonel and brigadier-general in the regular army for gallantry. He was mustered out of the volunteer service in 1865, and assigned to the command of Fort Laramie, Kan.

SLICER, slī'sėr, **Thomas Roberts,** American Unitarian clergyman: b. Washington, 16 April 1847; d. 29 May 1916. He was a Methodist minister for 10 years, then entered the Unitarian ministry, and in 1897 was made pastor of the Church of All Souls, New York. He is the author of ‘Doctrine of the Unity of God in the First Three Centuries’ (1893); ‘The Power and Promise of the Liberal Faith’ (1900); ‘Book of Common Worship’; ‘The Great Affirmations of Religion’ (1900); ‘One World at a Time’ (1902); ‘The Way to Happiness’ (1907); ‘From Poet to Premier’ (1909). He received the honorary degree of doctor of divinity from Brown University in 1914.

SLICKENSIDES, a miner's term for the striæ, furrows, or polished surfaces covering the walls of fissures, and sometimes the surfaces of bed rock. They result from the friction of two portions of rock moving one against the other under great pressure. The occurrence is common, being often found on the walls of faults and joints.

SLIDE-RULE, an instrument for doing various mathematical operations in a mechanical way. It consists of two or more very accurately graduated and numbered pieces of wood or other material, one or more of which slides in a groove in the other. It may be flat or cylindrical. By shifting the movable slide or slides a variety of tedious arithmetical problems can be conveniently solved. It is almost indispensable to the draftsman and machine designer.

SLIDELL, slī-dĕl', **John,** American politician: b. New York, 1793; d. London, 29 July 1871. He was graduated at Columbia in 1810, studied law, and in 1819 removed to New Orleans. From 1829 to 1833 he served as United States district attorney for Louisiana; was a member of Congress, 1842–45; and in 1845 was appointed Minister to Mexico, but was not received by the Mexican government. In 1853 he entered the United States Senate, but resigned when Louisiana seceded in 1861. In September of that year he was appointed as associate of James M. Mason (q.v.), commissioner of the Confederate States to France. The two commissioners ran the blockade of Charleston, S. C., and sailed from Havana on the English steamer *Trent*. The *Trent* was overhauled 8 November by Capt. Charles Wilkes (q.v.) with the *San Jacinto* of the United States navy. The two commissioners were arrested and held for a while as prisoners at Fort Warren in Boston Harbor. The act of Wilkes was disavowed by the United States upon demand of the British government, and 1 Jan. 1862 the commissioners sailed for England. Slidell's mission which, besides other things, contemplated recognition of the Confederacy by the French government, failed in its object, France refusing to move, either in that matter or in making a commercial convention, without the co-operation of England. He was successful, however, in securing a large loan for the Confederate States. After the war Slidell settled in London. See TRENT AFFAIR.

SLIDING, *in economics,* (1) a scale of prices for manufactured goods, which is regulated by the rise and fall in the price of the raw material. (2) A scale of wages which rises and falls in proportion to the rise or fall in the market value of the goods produced, or some other varying condition.

SLIDING-KEEL. See CENTRE-BOARD.

SLIEVEN, slē'vĕn, **SLIVEN,** or **SLIVNO,** Bulgaria, in Rumelia, 70 miles north of Adrianople, near the famous «Iron Gate» defile. It is an industrial town; the chief manufactures are homespun cloths, attar of roses and black wine for which it is famous. There is an extensive trade in homespun cloths and some in silk. A government factory for the making of military uniforms is located here. At the annual fair an extensive business is transacted. Pop. about 26,000.

SLIGO, slī'gō, Ireland, (1) capital of County Sligo, on a bay of the same name, 110 miles northwest of Dublin, on the Garvogne River. The chief buildings are a Roman Catholic cathedral, town-hall, lunatic asylum, etc., also an abbey of the 15th century. Its industrial works are corn- and saw-mills and a brewery. The exports are cattle and agricultural produce, especially to Glasgow and Liverpool. Sligo was in early times a walled city with a castle for protection (1242), and its beginning was a Dominican abbey. Nearby is a group of cromlechs. Pop. 10,870.

(2) Sligo is a coast county of Connaught, northwest Ireland, and comprises 707 square miles. The coast bays are numerous, and the

largest are Killala and Sligo Bay. The highest points are Slieve Gamph and the Ox mountains (1,770 feet). Lough's Arrow and Gill are picturesque lakes. The Moy, Owenmore and Garvogne rivers are navigable. Iron is abundant. Agriculture and stock-raising are the chief occupations. Coarse linen and woolens are manufactured. The principal towns are Sligo, Ballina, Ballymote and Tobercurry. In the county are found ancient caverns, raths, cromlechs, an ancient abbey at Ballysadare and a round tower at Drumcliffe. The population declines, being 84,083 in 1901 and 79,045 in 1911.

SLIME MOULD. See FUNGI.

SLING, a pocket with a stout string or cord tied to each end, for holding temporarily a stone or the like, whirling it around rapidly and then discharging it by releasing suddenly one of the cords. It is a very efficient weapon in the hands of an expert, and was a very general instrument of war among the nations of antiquity. The biblical story of David's victory over Goliath with the sling is well-known. The people of the Balearic Islands excelled at the sling and were much employed in the armies of the Romans and Carthaginians. Livy mentions some tribes still more dexterous than these islanders, who discharged stones with so much force that neither buckler nor headpiece could resist them and who hit their mark to a hairbreadth. In the book of Judges (ch. xx) it is recorded that in the town of Gibeah, in the tribe of Benjamin, there were 700 chosen men, left-handed, every one of whom could sling stones at a hair breadth and not miss. They persisted in use up to the 17th century, when they were used to throw hand grenades.

SLINGELANDT, slĭn'gĕl-länt, **Pieter Cornelisz van,** Dutch painter: b. Leyden, 20 Oct. 1640; d. there, 7 Nov. 1691. He was a pupil of Gerard Dow and produced portraits and clever genres, generally dealing with subjects relating to the great guilds or to civic life, and notable for life-like expression, true color and atmosphere and suffused with a delightful humor. His principal pictures are 'Children Blowing Bubbles' (in the Uffizi, Florence); 'The Unmusical Puppy'; 'The Violin Player'; and 'The Singing Lesson.'

SLIP, (1) moistened clay prepared for the decoration of pottery and terra cotta. It is usually colored. See POTTERY. (2) A space between piers in which a vessel may lie, as a ferry-slip.

Slippage, in mechanics, the amount or character of a slip. A loose joint in a piston-rod might involve a corresponding slippage of the piston, during which motion it would do no useful work. A propeller cannot push a ship as far in the water as its actual travel would indicate theoretically and the difference is the slippage. Allowance made for play is also called slip or slippage.

SLIPPERY ELM. See ELM.

SLIVEN, slē'vĕn. See SLIEVEN.

SLIVERING MACHINE, one of a class of machines used in match-making, dividing match-cards, forming veneers, etc. Excelsior and toothpicks are made automatically on slivering machines. For match-making they usually include mechanism for forming the match-heads. For cutting various small wooden pieces used in joinery, and separating the cards of matches, a gang-saw type of sliverer is employed. In forming strips of veneer, the sheet of veneer is first cut by a stationary knife and then a plunger pushes the veneer down upon the slivering knives.

SLOAN, Charles H., American politician: b. Monticello, Iowa, 2 May 1863. In 1884 he was graduated at the Iowa State Agricultural College; from 1884 to 1887 was superintendent of schools at Fairmont, Neb., was admitted to the bar in 1887; practised at Fairmont from 1887 to 1891, and at Geneva, Neb., after 1891. In 1890–94 he served two terms as attorney of Fillmore County and was a member of the Nebraska senate in 1894–96. From 1911 to 1919 he was a member of Congress from the fourth Nebraska district.

SLOANE, slōn, **SIR Hans,** English naturalist: founder of the British Museum: b. Killileagh, County Down, 16 April 1660; d. Chelsea, 11 Jan. 1753. He studied medicine in London, Paris and Montpellier, and in 1684 settled in London for the practice of his profession. In 1685 he was admitted a Fellow of the Royal Society, of which he was appointed secretary in 1693 and president in 1727. His 'Voyage to the Islands of Madeira, Barbados, Nieves, Saint Christopher's and Jamaica, with the Natural History of the Last' (1707–25) was the result of observations made in the West Indies during his stay as physician to the governor in 1687–89. George I created him a baronet and physician-general to the forces in 1716, and on the accession of George II he was named physician in ordinary to his majesty. See BRITISH MUSEUM.

SLOANE, Rush Richard, American lawyer and capitalist: b. Sandusky, Ohio, 18 Sept. 1828. He early entered political life, was twice elected probate judge, was a delegate to the convention which organized the Republican party in 1856 and a prominent member of various political committees and conventions. He was conspicuous in the abolition movement and was prosecuted by the United States government in 1852 for having defended six runaway slaves, the only person prosecuted for that offense under the Fugitive Slave Act of 1850. He was appointed general agent of the Post Office Department by President Lincoln in 1861, assisted in the organization of the "Cassius M. Clay Brigade" for the protection of Washington in 1861 and served as one of its members. He was mayor of Sandusky 1879–81, built the "Big Four" Railroad between Springfield and Columbus, Ohio, was railroad president for 10 years and largely interested in various commercial enterprises.

SLOANE, Thomas O'Conor, American scientist: b. New York, 24 Nov. 1851. He studied at Columbia and was professor of natural sciences at Seton Hall College, New Jersey. He invented the self-recording photometer, the first instrument to record mechanically the illuminating power of gas; described a new process for determining sulphur in illuminating gas and has lectured on scientific topics. He is the author of 'Home Experiments in Science' (1888); 'Electricity Simplified' (1891); 'Standard Electrical Dictionary' (1892); 'Liquid Air and the Liquefaction of Gases' (1899), etc.

SLOANE, William Milligan, American historian: b. Richmond, Ohio, 12 Nov. 1850. He was graduated at Columbia in 1868, studied at the universities of Berlin and Leipzig in 1872–76, acting during much of that time as private secretary to George Bancroft, then United States Minister to Berlin. He was professor at Princeton in 1876–96, edited the *Princeton Review* in 1886–89 and since 1896 has occupied the Seth Low chair of history at Columbia. He has published ‘Life and Work of J. R. W. Sloane’ (1888); ‘Life of James McCosh’ (1892); ‘The French War and the Revolution’ (1893); ‘Life of Napoleon’ (4 vols., 1897); ‘The French Revolution and Religious Reform’ (1901); ‘Parteiherrschaft in America’ (1913); ‘The Balkans’ (1914); ‘Party Government in America’ (1915), etc.

SLOAT, slōt, **John Drake**, American admiral: b. New York, 1780; d. New Brighton, Staten Island, N. Y., 28 Nov. 1867. He was appointed a midshipman in the navy in 1800 but was mustered out in the following year after the passage of the peace establishment act. At the outbreak of the War of 1812 he re-entered the navy as sailing master of the frigate *United States*, and for gallant conduct in the capture of the British ship *Macedonian* received a silver medal and the thanks of Congress. He was engaged in the expedition for the suppression of the West Indian pirates in 1823–25, holding chief command after 1824, captured the pirates *Palmyra* and *Colfrecinos* and the pirate stronghold Foxhardo in Porto Rico. He was promoted to master-commandant in 1826, captain in 1837 and in 1840–44 was in charge of the Portsmouth navy yard. He commanded the Pacific squadron in 1844–46, had charge of the Norfolk navy yard in 1847–51, and then superintended the construction of the Stevens battery. He was retired in 1861, but received rank as commodore in 1862 and as rear admiral in 1863.

SLOCUM, slō'kŭm, **Henry Warner**, American soldier: b. Delphi, Onondaga County, N. Y., 24 Sept. 1827; d. Brooklyn, N. Y., 14 April 1894. He was graduated at West Point, but resigned his commission and began the practice of law. When the Civil War broke out he was commissioned colonel of volunteers in the Union army. He was at the first battle of Bull Run, was made brigadier-general in 1861 and major-general in 1862. He then commanded a corps of the left wing of Sherman's army, which he led on the «March to the Sea.» After the war was over he resigned, resumed the practice of law in Brooklyn and sat in Congress 1869–73.

SLOCUM, Joshua, American navigator: b. Annapolis County, Nova Scotia, 20 Feb. 1844. He engaged in a seafaring life from early boyhood, studied nautical astronomy and marine architecture, and for many years sailed from the coast of California to points in China, Japan, Australia and the Spice Islands In 1874 he built a steamer of 90 tons register at Olongapo, Subig Bay, Luzon, and in 1892 built at Fairhaven, Mass., the *Spray* of nine tons register, in which he sailed alone around the world in 1898. He published serially in leading magazines accounts of his voyages in the *Spray* and in the *Destroyer* and has also written ‘Voyages of the Liberdale from Brazil to New York’ (1891); ‘Voyage of the Destroyer’ (1894); ‘Sailing Alone Around the World,’ etc.

SLOCUM, William F., American educator: b. Grafton, Mass., 29 July 1851. He was graduated at Amherst in 1874, and at Andover Theological Seminary in 1878. He held Congregational pastorates at Amesbury, Mass., 1878–83, and Baltimore, Md., 1883–88. He subsequently became president of Colorado College. He has written on sociological subjects.

SLOCUM DISASTER, the burning of the excursion steamboat *General Slocum* on the East River, 15 July 1904, in which about 1,000 lives were lost. The *General Slocum* left her pier in the East River with about 1,800 persons on board, most of them members of Saint Mark's Lutheran Church, New York. She had proceeded but a short distance up the river when fire was discovered on board, and in the panic ensuing, as the flames spread rapidly, many passengers threw themselves overboard and were drowned. Delay in beaching the boat was charged, but it was finally grounded on North Brother Island. Many more lives were lost even than through fire or drowning, owing to the panic which seized crew as well as passengers, and to the fact that the life-preservers were old and worthless. The United States Steamboat Inspection Service placed the number of lives lost at 938, while the New York police estimate was 1,031. Official investigation showed that the steamboat had not been carefully inspected, that the crew was practically untrained for an emergency and that the life-preservers were of absolutely no value through deterioration due to age. The captain, William H. Van Shaick, was in 1906 sentenced by the United States District Court to 10 years' imprisonment on a charge of criminal negligence; but the steamboat company evaded legal responsibility for the tragedy.

SLOE, or BLACKTHORN, a European shrub (*Prunus spinosa*), from two to 15 feet high, much branched and very spiny. The small, white, rosaceous flowers appear before the leaves, which are alternate, ovate with obtuse tips and finely serrate. The fruit is a globose drupe about as large as a cherry, almost black, with a bloom, and containing a stone slightly flattened and acute on one edge. Its variety, the bullace (*P. insititia*), has by some been called a species and is supposed to be one of the plants from which European plums originated. The pits have been found in Swiss lake-dwellings, and the fruits have been used for preserves, for making fictitious port and adulterating the genuine wine and for a black dye. The leaves were an adulterant of tea and the stem furnishes the knobby «blackthorn» stick of Irish fame.

SLOOP. See SHIP.

SLOSSON, Edwin Emery, American editor, educator and author: b. Albany, Kan., 7 June 1865. He was graduated at the University of Kansas in 1890 and took his Ph.D. at the University of Chicago in 1902. He was professor of chemistry at the University of Wyoming in 1891–1903, serving also as chemist of the Wyoming Agricultural Experiment Station. From 1903 he was literary editor of the *Independent*, New York, of which he was also at various times managing editor. In 1912–14 he was associate on the faculty of the Columbia University school of journalism. He is a contributor of literary and scientific articles to magazines and is author of ‘Great American Universities’ (1910); ‘Major Prophets of To-day’ (1914); ‘Six Major Prophets’ (1917), etc.

SLOTH, an edentate mammal of the family *Bradypodidæ*. (See Edentata). The best known are the unau or two-toed sloth (*Cholœpus didactylus*) of Brazil and the ai or three-toed sloth (*Bradypus tridactylus*) of northern South America. This family is distinguished by the flat short head, and the elongated legs, furnished with powerful compressed and curved claws. No incisor teeth exist, but simple columnar molars without enamel are developed. The stomach is somewhat complex. The three-toed species are unique among mammals in possessing nine cervical vertebræ. The long bones are solid, and destitute of marrow or medullary cavities. Being adapted solely for an arboreal life, the fore-limbs exhibit a much greater length than the hind-limbs, and a powerful muscular organization. The forearm possesses an unusual degree of mobility, the feet being strong and the claws very powerful and permanently flexed. The usual mode of progression of these animals is to move back downward suspended from the branches of trees, and they are known to sleep in this curious position. On the ground the sloths are entirely out of their element; the feet being jointed in an oblique manner to the limbs, the palms and soles are thus naturally turned inward, and the claws themselves are bent inward toward the soles of the feet. Three toes exist in this species, and its general color is a brownish gray, with darker tints on the face and limbs. The fur is of very coarse character, and when the animals are living in their damp native forests is tinted green from the presence upon it of a minute green plant or alga. The unau, as its specific name implies, has but two toes, and 23 pairs of ribs exist, no mammal possessing a greater number than this. Its average length is about two feet, and its color is a lighter gray than that of the ai. The tail in both species is either wanting, or at the most is rudimentary. The sloths are proverbially sluggish in their movements and are remarkably tenacious of life. They are nocturnal and feed upon leaves and shoots which are secured with the slender prehensile tongue. Generally only the two genera mentioned above are recognized, but by some zoologists the three-toed sloths are subdivided. The number of species is also doubtful. About 15 have been described, all confined to South and Central America. The Megathium and Mylodon (q.v.) were gigantic sloth-like terrestrial mammals, the remains of which are found abundantly in the Pleistocene deposits of North and South America. Consult Flower and Lydekker, ‘Mammals Living and Extinct’ (London 1891); Leidy, ‘Extinct Sloth Tribe of North America’ (Washington 1855); Bates, H. W., ‘Naturalist on the Amazon’ (1910).

SLOTH-BEAR, or **ASWAIL.** See Bears.

SLOTH-LEMUR, or **SLOW LEMUR.** See Lemurs.

SLOUGH GRASS. See Fibre.

SLOVAKS, slō-văks', **the name** of the Slavic inhabitants of northern Hungary. They are the descendants of the Slavs who settled on the south of the Carpathians between the Danube and the Theiss, where they maintained themselves for centuries, and in the 9th century formed the nucleus of the great Moravian empire. After the battle of Pressburg, in 907, in which this empire was overthrown by the Magyars, the Slovaks gradually fell under the yoke of the conquerors. At the present day they are scattered over most of the counties of Hungary, and in the northwestern counties they form the majority of the inhabitants. They are also found in Moravia in the districts adjoining Hungary, and in detached settlements in Lower Austria, Bukowina and Slavonia. The Slovaks possess in their own dialect a number of beautiful popular songs, collections of which have been published at different times (Pest 1823–27; Buda 1834). There is a grammar of the language by Victorin (Budapest 1878). The total number of Slovaks is about 2,500,000. Consult Copek, J., ‘The Slovacs’ (New York 1906); Seton-Watson, ‘Racial Problems in Hungary’ (London 1909). See Slavs.

SLOVENES, slō-vĕnes', a Slavonic people often confused with the Slovacs. Most of them are to be found in the Austrian provinces of Carinthia and Styria, although there are a few in Italy and Southwestern Hungary. They came from farther east about the 7th century, and were chiefly Christianized. They possessed a Bible and grammar in their own language, but during religious differences in the 16th century these were mostly destroyed. They are now mainly Runich in their faith. Their language is split into eight dialects. They have a lyceum at Laibach containing a choice collection of Slovene books. They number about 1,300,000. Consult Strekelj, ‘Slovenske Narodne Pesmi’ (Laibach 1895).

SLOVENIANS, or **SLOVENES,** the native name of the Slavic inhabitants of Styria, Carinthia, Carniola, the Austrian maritime territory, a narrow strip in the west of Hungary and in Venetian Friuli. By the Germans they are often called Wends or Winds. They settled in these districts toward the end of the 6th century, having migrated there from Pannonia. Christianity was introduced among them not later than the 8th century. Their land was incorporated under the name of the Windic March with the empire of Charlemagne. Out of this march were afterward formed the duchies of Styria, Carinthia and Carniola, which fell to Germany and ultimately to Austria. Their total number is about 1,300,000. The language of the Slovenians is closely allied to the Servian. (See Slavs). It possesses some very old and valuable monuments of the Slavonic tongue. The oldest, which is at the same time the most ancient of all the Slavonic literary relics, is the Munich manuscript, of the date 957–994, written by Bishop Abraham, of Freising, in Bavaria, and consisting of three articles on religious subjects. It is printed in Kopitar's ‘Glagolitza Clozianus’ (Vienna 1836). After a long slumber the dialect was resuscitated for literary purposes in the 16th century, when several ecclesiastics brought it to a high state of development. In 1584 Bohoricz published a grammar of the language, and in the same year there appeared a translation of the whole Bible. The best grammar is that of Kopitar (Laibach 1808). A dictionary by Jarnik and Mark was published in 1832, and collections of popular songs were published by Wraz and by Korytko in 1839. See SLAVS.

SLOW-WORM, or **BLIND-WORM,** a limbless, snake-like lizard (*Anguis fragilis*) of Europe which creeps about beneath dead leaves, in rotting logs, etc., in search of insects. It is 15 to 20 inches in length, smoothly scaly, brown striped and perfectly harmless.

SLOWACKI, slō-vä'kē, **Julius,** Polish poet: b. Kremenecz, in Volhynia, 23 Aug. 1809; d. Paris, 3 April 1849. He was educated in the University of Vilna. His first work was the poetic tale 'Hugo'; this was followed by the tragedy 'Mindowe' (1829); the poem 'Mnich' (the 'Monk'); and the tragedy 'Marya Stuart' (1830); in all of which he was under the influence of Byron; but escapes from it in the 'Ode to Liberty'; 'Hymn to the Mother of God'; and 'Song of the Lithuanian Legion' (1831). The sentiment of Polish nationality finds fullest expression in the dramatic poem 'Kordyan' (1834), and in the tragedy 'Mazeppa.' Slowacki reaches the height of his lyric power in the poem 'In Switzerland.' His last great work, left incomplete, was 'King Spirit,' which he designed to be a «legend of the ages» of Polish history See KORDYAN.

SLOYD. See MANUAL TRAINING.

SLUGS. See SNAILS AND SLUGS.

SLUICE, *in hydraulics,* any artificial channels of small dimensions, as a frame of timber, stone or concrete, serving to retain and direct the water of a canal, dam, etc., and often to give it vent; also called sluiceway. Hence, an opening; a source of supply; that from which any thing flows; as, the eyes are the lachrymal sluices of sensibility. The form used in placer mining is a long wooden trough, with longitudinal cleats in the bottom and occasional cross-cleats. Quicksilver being placed in the cleats tends to hold any gold in the dirt that is washed through the sluice.

SMACK, a small vessel rigged as a cutter, sloop or yawl, used in the coasting trade and in fishing.

SMALCALD, smăl'kâld, or **SCHMALKALDEN,** shmăl'kăl"dĕn, Prussia, a town in the district of Cassel, on the south slope of the Thüringer Wald, 35 miles south of Muhlhausen. It contains a Gothic church built in the 15th century and the Wilhelmsburg Castle, in which there is a collection of antiquities. In the old town-hall the Smalcaldic League was concluded in 1530 and the Smalcaldic Articles signed in 1537 by the Protestant leaders. The town has several institutions for higher education, and a trade-school for the iron and steel industry is the most important. Pop. 9,529.

SMALKALDIC LEAGUE. See SCHMALKALDIC LEAGUE.

SMALL, John Kunkel, American botanist: b. Harrisburg, Pa., 31 Jan. 1869. He was graduated at Franklin and Marshall College in 1892 and took his Ph.D. at Columbia in 1895. He was curator of the herbarium at Columbia University in 1895–99, and at the New York Botanical Garden in 1899–1906, since when he has been head curator there. Author of 'Shrubs of Florida' (1913); 'Flora of the Florida Keys' (1913); 'Flora of the South Eastern United States' (1913), etc.

SMALL ARMS. Included under this title are the various types of firearms that from their portable form may be classed as hand weapons, as distinguished from ordnance. In their earliest forms, small arms do not differ from cannon except in size. These weapons, dating from the 14th century, were suspended from the neck of the trooper. This cavalry weapon, known as the bombardello, was succeeded by the hand culverin, mounted on a wooden stock, and fired from a rest by a slowmatch. It took two men to fire it and, except for the terror caused by its noise, was a far less effective weapon than the crossbow. The stock and barrel gradually took on a form not unlike the present one, and the slowmatch was fastened to a serpentine or cock on the piece. This was manipulated by a lever or spring, and transferred the fire from a match on the barrel to a flashpan containing powder and situated just under the touchhole. This piece, known as the matchlock, was partly superseded in 1515 by the wheellock, in which the trigger released a clockwork which rotated a grooved metal wheel against a piece of pyrites or flint, thus igniting the priming. The wheellock was too expensive for military purposes, and was confined to fowling pieces, which it first made reasonably convenient.

The flintlock originated in Spain about 1600, though it did not come into general military use till nearly a century later. The priming was ignited by the contact between a flint held in a frame not unlike the serpentine of the matchlock and the cover of the flashpan. The flintlock was the prevailing arm as late as 1840. It was almost invariably muzzleloading, as assumed the forms of pistol, smooth bore musket and rifle. The rifle dates back almost to the beginning of the history of firearms, and is characterized by helical grooving on the inside of the barrel. This secures against the escape of gas past the bullet, and gives a predetermined axis of spin to the bullet, thus increasing the accuracy of fire.

In 1807 a Scotch clergyman by the name of Forsyth patented the use of fulminates for the ignition of the charge in firearms. This gradually came to be adopted in place of the flintlock. The mechanism was much like that of the flintlock: the flint was replaced by a metal hammer, and the flashpan and touchhole by a nipple containing a metal cap of fulminate. The reinvention of the breechloader (for the breechloader in a primitive form is as old as the gun itself) took place soon afterward. The first military rifle was the needlegun of the Prussians, invented by Dreyse in 1839 It was a crude bolt action weapon with very imperfect obturation, as a paper cartridge was used. The French soon followed suit, first with the Tabatière and then with the Chassepot. In 1866 the British adopted the Snider rifle, remodeled from the old Enfield. The Martini falling-block rifle was adopted in 1871. In 1872 the Mauser boltaction rifle was made the arm of the German army. This gun is the type of most modern military rifles.

During this period, the ammunition underwent improvement along with the gun. The round bullet was replaced by one cylindroconical in shape, and the cartridge case of paper gave way to one, first of coiled brass, and then of drawn brass. This made escape of gas impossible and solved the problems which had vexed the inventors of breechloading arms from the 15th century on. The magazine principal gradually came into use — first in the form of a tube magazine now retained only by the French Lebel — then of a box under the action and finally of a box loaded with five or six cartridges at once by a clip or charger. The calibre was then reduced to the neighborhood of .3 inches or less, and a muzzle velocity of over 1,800 feet per second was attained. This was made possible by the invention of the copper-jacketed, non-stripping bullet by Major Rubin of the Swiss army. Soon afterward smokeless powder was introduced, and the military rifle had assumed practically all its present features. The Krag-Jorgensen and Springfield mentioned below are typical military arms.

For many years after the arrival of the early colonists, imported weapons were used in America almost exclusively. On the Continent, especially among the Germans, Swiss and French, much attention had been given to the production of arms of precision and greater progress had been made than in England. The Puritan settlers in New England remained satisfied with their matchlock and flintlock smooth-bore arms until the Revolutionary period. Their traditions and training were such that the use of deadly weapons, excepting in cases of defense from enemies and for the purpose of obtaining game in order to sustain life, was frowned on as a practice to be discouraged.

It is to the Teutonic settlers of Pennsylvania that we must turn for the earliest examples of typical American weapons. Peter and Heinrich Leman established themselves near Lancaster, Pa., at the beginning of the 18th century and in 1732 were making rifled arms.

Naturally the first rifles produced were of the contemporary German model, short-barreled, ungainly pieces of large bore. They were flintlock, loading from the muzzle, a mallet being necessary in order to start the bullet into the deeply cut rifling, considerable pressure being afterward required in order to seat the bullet down upon the powder charge. The frontiersmen appreciated the value of an arm that gave the accuracy of which these weapons were capable as compared with smooth-bore muskets.

But such laborious methods of loading were impracticable under conditions of Indian warfare and in the pursuit of dangerous game. So the linen or buckskin patch, impregnated with tallow, was devised to be wrapped about the bullet when loading. This seated readily and the rifles were found to shoot farther and truer than by the previous method. By lengthening the barrel greater accuracy as well as ease of sighting and steadier holding ensued. The barrel was usually from 40 to 45 inches in length, octagonal, and of a bore from 35 to 40 round balls to the pound. The stock was made of maple or walnut extending the full length of the barrel, the ramrod being carried in a slot underneath. A cheekpiece was fashioned near the breech, also a patch box, and the butt of the stock terminated in a crescent-shaped plate to be held against the upper arm instead of the shoulder. The locks were generally fitted with single or double set triggers. The stock was intentionally slender and light, the total weight of the rifles being about 10 pounds. Sights were very low on the barrel, consisting of an oval silver blade at the muzzle and at the breech a straight bar with a fine notch, frequently inlaid with a narrow vertical strip of silver. Though the range of these rifles was seldom effective beyond 200 yards, within that distance great precision as well as a flat curve of trajectory was secured, the proportion of the weight of the bullet to the powder charge being about three to one.

In the Far West a change in model was made in order to adapt the rifle to the conditions of buffalo hunting and use on horseback. A rifle of this type made in Missouri in 1820 has a 34-inch octagonal barrel with a maple stock extending half way to the muzzle. The bore is slightly over one-half inch in diameter, and a charge of about 90 grains of powder was used. This arm has double set triggers and weighs about 10½ pounds.

In the South the standard rifle was of relatively small bore. Bullets of about 70 to 80 to the pound were found to be sufficient for still hunting the small game of the section, such as wild turkeys and squirrels. Though larger calibres were to be found to a certain extent, the Kentucky smallbore rifle attained a widespread reputation.

The sport of target or turkey shooting from an artificial rest at distances up to 40 rods developed a type of rifle which while very accurate was useless for field purposes, weighing from 20 to 40 pounds. A bore of from .40 to .60 calibre was customary with an elongated projectile and telescope sights were frequently applied. Carlos Clark of Windsor, Vt., in 1836 adopted the false muzzle for the purpose of preventing wear on the rifling when loading, and it was generally used with this style of arm.

The first military weapon employed by the United States government was the Charleville musket, the national arm of France, which was brought to this country in large quantities during the Revolutionary War through the influence of Marquis de Lafayette. The French model of 1763 served as an example for American private manufacturers who were encouraged by the government. These muskets were heavy smooth-bore flintlocks taking an ounce ball and fitted with bayonets. In 1795 the government armory at Springfield, Mass., was established and the manufacture of muskets by the government was begun during that year. The Charleville musket as improved in 1797 continued to be the standard type of military weapon. The Harper's Ferry armory was established in 1796, but the fabrication of arms was not begun until 1801. In 1804 rifles were produced there in small quantities. A rifle resembling the sporting model of the period was brought out at this armory in 1814. It had a half-octagon barrel, short forestock, no bayonet and a curved butt plate, and was adapted to a one-half ounce ball. The Hall rifle issued in 1818 was the first breechloading rifle to be manufactured by the government. It was originally a flintlock, but was later changed to a percussion lock arm. In 1822 the muzzleloading principle was still retained in the musket and rifle of that date, issued as a new model. The musket and rifle of the model of 1842 were the first service weapons to be originally made with percussion locks.

During the Civil War a great variety of arms were in use. The percussion principle was applied to many of the flintlocks in the possession of the government and the musket and rifles made in the government armories were adapted to that style of ignition. Breechloading rifles and carbines of private manufacture were purchased in large quantities, several types of repeating arms doing excellent service. Foreign weapons were also used to some extent, especially in the Confederate service.

At the close of the war the government deemed it desirable to transform the large number of muzzleloading rifles on hand into breechloaders. Many devices for this purpose were submitted to the Ordnance Board and that presented by Smoat, a mechanic at the Springfield armory, was adopted, and the rifles were known as the model of 1865. The progress in the development of ammunition resulted in the production of the rim fire cartridge, a great improvement over the powder and ball charge enclosed in paper previously in use. Centre fire cartridges of .58 calibre, the brass shell containing 70 grains of power and 450 of lead, became the standard ammunition for the later rifles of this model. In 1868 the calibre was changed to .50, retaining the same weight of bullet and powder charge.

In 1870 the Ordnance Board recommended for trial from the many rifles submitted to them the Remington, Sharps and Ward-Burton, all taking the regulation .50-calibre cartridge. They were all tried in the field, the verdict being that none of them were superior to the Springfield. A reduction in calibre was recommended, however; resulting in the model of 1873 Springfield rifle, calibre .45 taking 70 grains of powder and a 405-grain bullet. In 1885 a bullet weighing 500 grains was adopted as the standard for this cartridge.

The .45-calibre Lee-Remington, and later the .236-calibre Lee straight pull rifles, both embodying the bolt mechanism, were adopted for the United States navy.

Flintlock pistols of large calibre and smooth bore were considered an indispensable weapon of defense during the early history of our country, no traveler on horseback or by stage feeling secure unless one of these weapons was in his possession. Accuracy was a secondary consideration, as they were intended to be used only at short range, and hence were frequently loaded with buckshot as well as with single bullets. Duelling pistols were of a different model, the stocks being attached at an extreme angle with the barrel in order to allow the owner to assume the approved duelling position, with the elbow close to the body. These pistols were made in pairs and they frequently showed a high degree of skill on the part of the makers, being elaborately engraved and inlaid.

In 1830 Samuel Colt began to devote his attention to developing a pistol with a revolving cylinder containing a number of chambers. His efforts were soon crowned with success, and his revolvers gained a wide reputation. The cylinders were loaded from the muzzle with powder and ball, each chamber containing an independent breechpin adapted to a percussion cap. These weapons were made with a solid frame. Metallic cartridges added much to their utility. Smith and Wesson brought out a revolver with a hinged frame, allowing the chambers to be exposed for loading and the simultaneous ejecting of the discharged shells. The products of these two firms soon became the models for manufacturers throughout the world.

For hunting rifles the breechloading system came into general use during the period of the Civil War. In the West the Sharps .45-calibre rifle chambered for a cartridge containing from 90 to 120 grains of powder and a 550-grain bullet, paper patched, was the standard buffalo hunter's weapon. These rifles weighed from 11 to 16 pounds and were usually equipped with set triggers.

The magazine principle was making rapid advances at this time. In the Henry rifle, the predecessor of the Winchester, the cartridges were loaded into a tube under the barrel, being forced by a spiral spring into the carrier and thrown into the chamber by the action of the lever forming the trigger guard. The standard cartridge remained the .44-40-200 in both rim and later central fire. In 1870 the express principle attracted the attention of sportsmen, consisting in the use of a large powder charge in proportion to the weight of the bullet in order to obtain a high velocity and increased striking power on large game. The .45-90-300 cartridge was one of a number brought out in response to this demand and adapted to the repeating system of rifles.

The formation of the National Rifle Association in 1871 resulted in a series of international long-range rifle contests in which the American teams won a majority of the matches both at home and abroad. The weapons used were of .44 and .45 calibre with from 90 to 120 grains of powder and paper patched bullets of from 500 to 550 grains of hardened lead. The limit of weight of these rifles was 10 pounds and the minimum trigger pull three pounds. Great skill was shown in the manufacture of these rifles and the results attained have not been surpassed in accuracy by later developments in weapons.

Target shooting as a sport became popular throughout the country as a result of these contests and, as many clubs were unable to obtain facilities for long-range practice, shooting at 200 yards in the standing position was widely adopted. The large bore rifles and heavy charges in use at the longer ranges were found to be unnecessary and a gradual reduction in calibres took place. For some years the limit of weight remained at 10 pounds. At the German-American schuetzenfests there were no restrictions as to the weight of the rifle or the trigger pull, and these weapons while impracticable in the field were nevertheless superior for their specific purpose. Hence a change in type in offhand weapons has come about and the standard weapon is the "schuetzen" model, weighing from 11 to 15 pounds. The .32 and .38 calibres are usually adopted. These rifles are frequently equipped with a palm rest, a rod extending down from the forestock, terminating in a knob, enabling the marksman to rest the left elbow on the hip. A cheekpiece, buttplate with horns to fit the arm, double set triggers, an aperture or pin head front sight covered with a hood, and a rear elevating vernier sight with a wind-gauge attachment on the tang of the rifle complete the outfit. Telescope sights are increasing in numbers. Lubricated grooved bullets slightly hardened with tin are used, many expert riflemen loading them through a false muzzle, the shell being afterward inserted at the breech. The advantages claimed for this system are the perfect fitting of the bullet to the grooves and the cleaning of the bore as the bullet is forced down through the rifling. Such weapons are capable of placing 10 shots in a 2-inch circle at 200 yards from a machine rest.

Target shooting with the pistol and revolver at distances up to 50 yards is a popular sport, encouraged by the United States Revolver Association. The modern single shot target pistol has a 10-inch barrel and is made in calibres of from .22 to .44, .22-calibre rim fire ammunition being generally favored. The accuracy obtainable is surprising, 10 shots having been placed in a 3-inch circle at 50 yards, the weapon being shot in the regulation position with the arm extended, free from artificial support. Revolvers for target purposes are usually of from .32 to .44 calibre, with barrels from six to eight inches in length.

Muzzleloading shotguns both flintlock and percussion were almost exclusively imported from England and the Continent. The products of Joseph Manton were unsurpassed for balance, fine shooting qualities and workmanship and served as models for American fowling pieces. Barrels and locks were largely imported, in fact it is only within a comparatively few years that many shotgun barrels have been made in this country. The introduction of the Lefaucheaux breechloading system from France in 1852 marked a great advance over previous inventions. A paper and brass-shell was used with a small percussion cap in the centre of the base of the cartridge, ignited by the blow of the hammer on a brass pin extending through the side of the head of each shell, this pin also affording a means for withdrawing the empty case. The barrels were hinged, the breech being opened for the insertion of the shells by means of an under lever. This system formed the basis for most American breechloading actions for double and single guns. Improvements have been made from time to time until to-day the American hammerless ejecting gun operated by a top lever using centre-fire shells is second to none. The various styles of single trigger mechanisms are gaining in popularity. The repeating shotgun is distinctly American, the mechanism in most cases being operated by the sliding motion of the fore end.

The various types of weapons we have mentioned have been developed during the era of black powder, a propellant which while producing remarkably uniform results has changed but slightly in its constituents during the past century.

The introduction of smokeless or nitro powder has marked a new era in the field of firearms. Its characteristic features are absence of smoke and fouling, reduced recoil, reduction in bulk and the attainment of high velocities with relatively low chamber pressures.

In military weapons smokeless powder was at once conceded to possess obvious advantages. During the Spanish-American War smokeless ammunition was made in large quantities for the .45-calibre Springfield rifle. The Ordnance Board after careful investigation adopted 15 Sept. 1892 the Krag-Jorgensen .30-calibre rifle. This arm is of the bolt-operated type, weighs nine and three-fourths pounds without the bayonet and has a magazine holding five cartridges. The cartridge contains a bullet of 220 grains, consisting of a lead core and a steel jacket, the charge of smokeless powder giving a muzzle velocity of 2,000 feet per second as compared with 1,300 feet for the .45-calibre Springfield. A marked reduction of recoil, a flat curve of trajectory and economy in the weight of ammunition, as well as a great gain in rapidity of fire are notable features. A 10-inch twist is required to rotate properly the long bullet.

In 1903 the Ordnance Board adopted a new weapon known as the .30-calibre Springfield. The breech mechanism resembles in many respects a form of the Mauser-bolt action, which has given excellent satisfaction. The magazine is of the box type and is situated under the receiver. The cartridges are loaded from a clip, the magazine being provided with a cut-off so that the weapon may be used as a single loader if desired. Twenty shots have been fired in government tests in 28⅛ seconds. The cartridge has a cannelure cut around the head to engage in the extractor in place of the flange on the Krag-Jorgensen ammunition, allowing the cartridges to lie compactly in the magazine. The 150-grain jacketed bullet is used, the powder charge being increased in order to give a muzzle velocity of 2,700 feet per second. The rifle weighs, without bayonet, 8.69 pounds and is 3.60 feet long. The bayonet adds one pound in weight and 1.33 feet in length. In 1917 a rifle of similar dimensions, taking the same cartridge, but of a British type was adopted for use in the Great War.

The telescope sight is receiving attention for the equipment of military sharpshooters. The hyposcope, a detachable instrument consisting of a series of mirrors in a tube extending below the line of sight, allowing aim to be taken without the body of the soldier being exposed, has recently been placed before the Ordnance Board for adoption.

In hunting rifles the jacketed bullet and smokeless powder have found instant favor. For this purpose the lead core of the bullet is exposed at the point and upon striking game it expands or mushrooms, making a most deadly wound. Though the .30-40 government cartridge with a soft nosed bullet is largely used a number of special cartridges have been designed. The .405 Winchester adapted to their repeating rifles contains a 300-grain bullet, the smokeless powder charge developing a muzzle velocity of 2,204 feet per second and a muzzle energy of 3,235 foot pounds.

The application of smokeless powder to revolver ammunition has resulted in increased efficiency, as an unlimited number of shots may be fired with no perceptible fouling of the barrel or cylinder and a degree of accuracy maintained which was unattainable in the days of black powder.

Shotgun cartridges are almost exclusively loaded with this propellant and American machine-made guns are now being produced in weights of from six to seven pounds without the recoil becoming excessive or general effectiveness being sacrificed. The imported twist barrels have given way to special steel barrels of light weight and great tensile strength.

Automatic firearms have within the past few years attracted much attention. The term automatic literally means an arm that continues its acts of loading and firing after the first shot until the ammunition is exhausted. The arm that after firing the first shot performs the work of ejecting the empty shell, recharges the chamber and leaves the arm ready for the next shot by merely pressing the trigger, is a semi-automatic firearm, but the term automatic has been generally applied to this weapon. There are two systems in vogue at present, that by which a portion of the gas from the explosion is utilized to operate the breech mechanism; the other, in which the barrel recedes by the action of the recoil and accomplishes the same result. The latter system has been successfully applied to American repeating pistols which are a marked improvement over the revolver, as in the latter there is an inevitable escape of the explosive gases between the cylinder and the barrel. Metal-jacketed bullets and smokeless powder are used on these repeating pistols. Small-bore rifles designed on the recoil-operated system are a popular weapon and a repeating semi-automatic shotgun is now before the public. See MACHINE GUN.

There are many excellent types of firearms in use that seem well adapted for all time, but progress is constantly being made. The automatic and semi-automatic weapon will be an important factor in the warfare and sport of the future. See ARMS AND ARMOR; ARTILLERY; ORDNANCE; GUN; MUSKET, etc.

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SMALLEY, smâl'ĭ, **George Washburn**, American journalist: b. Franklin, Norfolk County, Mass., 2 June 1833; d. 1916. He was graduated at Yale in 1853, read law, and, having been admitted in 1856 to the bar, practised in Boston until the beginning of the Rebellion, when he became correspondent in the field for the New York *Tribune*. From November 1861 to October 1862 he acted as war correspondent, first in South Carolina, then in Virginia, in the campaigns of the Shenandoah and the Potomac, then was on the editorial staff till 1867, and in that year organized the *Tribune's* European bureau in London. There he remained in charge of all European correspondence until 1895, when he returned to the United States as American correspondent of the London *Times*. His publications are ‹Review of Bright's Speeches› (1868); ‹London Letters› (1890); ‹Studies of Men› (1895); ‹Anglo-American Memories› (1911; 2d series, 1912).

SMALLPOX. The date of the origin of smallpox, as is the case with other similar diseases, has not been definitely established. The probabilities are that it made its first appearance in the Orient and was thence introduced into western Europe. A severe epidemic of smallpox is said to have occurred in Iceland in 1241; we have no trustworthy record, however, of the disease before the 15th century, when it began to appear in Europe. Epidemics became progressively more common in the 16th and 17th centuries and reached their maximum of frequency and extent in the 18th century. For official data concerning the disease in the 17th and 18th centuries we are chiefly indebted to the London Bills of Mortality, which gave a weekly account of burials and christenings, and from 1629 to 1845 the specific causes of death, including smallpox.

It has been estimated that the population of London in 1685 was 530,000. The mortality from smallpox for an average of 10 years from 1681 to 1690 was over three in a thousand. In most of the years of the century, indeed, the mortality was in the neighborhood of two in a thousand, sometimes more and at other times less. This would mean an average of over 1,000 smallpox deaths in London a year. As it has been reckoned that about one in five would die, there were evidently about 5,000 cases of smallpox annually in the English capital.

As will be readily comprehended, smallpox was a great scourge before the days of vaccination; but a small percentage of people escaped its ravages. Indeed smallpox was as prevalent in the 18th century as measles is at the present time. Haygarth gives an account of an epidemic of smallpox in Chester, England, in 1774, at which time, out of a population of 14,713, 1,202 persons took the disease and 202 died. At the termination of the epidemic there were but 1,060 persons, or 7 per cent of the population, who had never had smallpox. In 1722 smallpox devastated the small English town of Ware, whose population numbered 2,515 souls; of this number there were only 914 persons susceptible to smallpox, inasmuch as 1,601 had already passed through an attack of the disease. During the epidemic referred to 612 persons were attacked, leaving but 302 individuals in the entire town who had never had smallpox. Eighty-five per cent of the population, therefore, were smallpox survivors.

With these official figures in mind, we may be better able to appreciate the general estimate of the extent of smallpox given by writers of the day. In 1802 Admiral Berkeley, in a speech before the House of Commons, said: «It is proved that in this United Kingdom alone 45,000 persons die annually of the smallpox; but throughout the world what is it? Not a second is struck by the hand of Time but a victim is sacrificed upon the altar of that most horrible of all disorders, the smallpox.» King Frederick William III of Prussia, in a dispatch dated 1803, stated that 40,000 people succumbed annually to smallpox in his kingdom. The French Minister of the Interior, in reporting on vaccination in 1811, estimated that 150,000 people died in France annually from smallpox; the disease is reported to have destroyed in Russia 2,000,000 lives in a single year. The distinguished mathematician, Daniel Bernouille, writing in 1760 to 1765, calculated that not less than 15,000,000 human beings died of smallpox every 25 years. This would give a yearly average of 600,000. Dr. Lettsom estimated that Europe alone claimed 210,000 victims annually. Juncker placed the yearly sacrifice from smallpox in Europe at 400,000. When to these figures are added the deaths due to devastating epidemics in Asia, Africa and America, the estimate of Bernouille does not appear to be overstated.

Smallpox was introduced in the western hemisphere by the Spaniards about 15 years after the discovery of America; in Mexico within a short period 3,500,000 persons are said to have died of the disease. It is alleged that in Mexico, smallpox has exterminated whole tribes of Indians, sparing no one to tell the story of the annihilation. Robertson refers to smallpox among the South American Indians as follows: «In consequence of this (various calamities), together with the introduction of smallpox, a malady unknown in America and extremely fatal to the natives, the number of people both in New Spain and Peru was so much reduced that in a few years the accounts of their ancient population appeared almost incredible.» Catlin states that of 12,000,000 American Indians, 6,000,000 fell victims of smallpox. Washington Irving's 'Astoria' makes mention of terrible epidemics of smallpox among the Indians in which «almost entire tribes were destroyed.» Lloyd, who translated Prince Maximilian's 'Travels in the Interior of North America,' states in the preface, in reference to a smallpox epidemic among the Indians in 1837: «The Big-Bellied Indians and the Ricarees, lately amounting to 4,000 souls, were reduced to less than the half. The Assiniboins, 9,000 in number . . . are, in the literal sense of the expression, nearly exterminated.»

According to records published by the government of Denmark, a devastating epidemic of smallpox appeared in Iceland in 1707, which destroyed 18,000 out of the 50,000 inhabitants; 36 per cent of the total population perished. It is stated on good authority that in the Danish colony of Greenland, in 1734, 6,000 to 7,000 persons perished from smallpox, representing nearly two-thirds of the population. The disease was introduced by a Danish ship.

The natives of New England likewise suffered great losses by smallpox. Robertson writes: «At the same time, 1631, the smallpox, a distemper fatal to the people of the New World swept such multitudes of the natives that some whole tribes disappeared.» In 1752 Boston had a severe epidemic of this dread disease. The population of Boston at that time was 15,684; of this number 5,998 had previously had smallpox. During the epidemic 5,545 persons contracted the disease in the usual manner and 2,124 took it by inoculation. Eighteen hundred and forty-three people escaped from the town to avoid the danger of infection. There were, therefore, left in the city but 174 people who had never had smallpox. The population at the end of the epidemic practically consisted of persons who had survived an attack of this fear-inspiring malady.

Smallpox was essentially a disease of children in former times; to such an extent was this true that the disease was called *Kindspocken* (childpox or *Kindsblattern*). Owing to the pronounced contagiousness of the disease and the almost universal susceptibility to it, smallpox was largely contracted during child life, as measles is at the present time. But comparatively few adults contract measles at the present day because they are protected by a previous attack in infancy or childhood. The same conditions obtained with relation to smallpox in the days before vaccination. The adult population represented mostly the survivors from smallpox in childhood. It was estimated that less than 6 per cent of persons were naturally insusceptible to the disease. Vaccination has totally changed the age period of smallpox. It is now excessively rare for a successfully vaccinated child under five years of age to die of the smallpox; it is even uncommon for a successfully vaccinated child under 10 years of age to die of the disease, as was adequately proved in the testimony presented before the British Royal Commission on Vaccination. Smallpox, perhaps more than any other disease, has inspired fear and terror in the popular mind because of its loathsome appearance, its extreme contagiousness and its disfiguring consequences. Lord Macaulay, writing of the untimely death from smallpox in 1694 of the young and beautiful Queen Mary of England, gives us a powerful pen picture of the ravages of this pestilence: «That disease over which science has since achieved a succession of glorious and beneficent victories, was then the most terrible of all of the ministers of death. The havoc of the plague has been far more rapid, but the plague has visited our shores only once or twice within living memory; and the smallpox was always present, filling the churchyards with corpses, tormenting with constant fears all whom it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover.» During certain periods in England, a very large percentage of the people were pock-

SMALL-POX

FIG. 1 Vaccinia on rabbit's cornea, showing several vaccine bodies in vacuoles adjoining the nuclei of epithelial cells. x 1000 diameters.

FIG. 2 Vaccine bodies in further development, showing the differentiation in structure. From the cornea of a rabbit. x 1000 diameters.

FIG. 3 Small small-pox parasite in protoplasm of epithelial cells of skin, in vacuoles adjoining the nucleus.

FIG. 4 A more advanced stage, showing beginning differentiation of the parasite.

FIG. 5 Larger parasites in stage preceding segmentation.

FIG. 6 Segmentation of parasite; from a case of experimental small-pox in the monkey.

These figures illustrate the first phase of development of the organism within the cell protoplasm. The nuclei are not affected. Micro-photographs multiplied 1000 diameters.

FIG. 7 Beginning of intranuclear development. Two nuclei with small round vesicles inclosed.

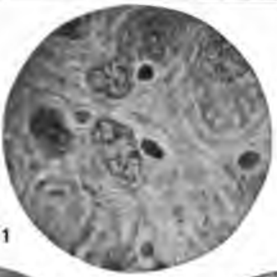
FIG. 8 Showing further development. x 1500 diameters.

FIG. 9 Beginning formation of a sporoblast within the nucleus. There are two sporoblasts consisting each of a central vesicle with a series of small chambers around it.

FIGS. 10, 11, 12 and 13 The further development of sporoblasts.

FIG. 14 Spore formation with free spores in the nucleus.

SMALL POX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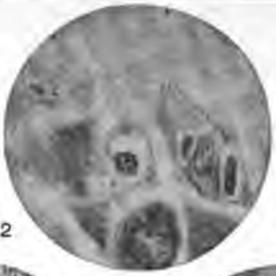
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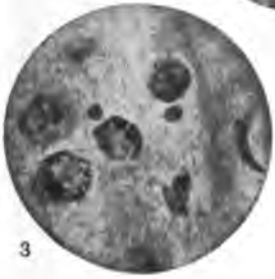
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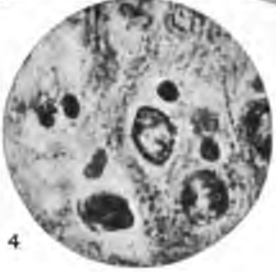
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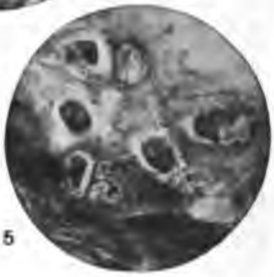
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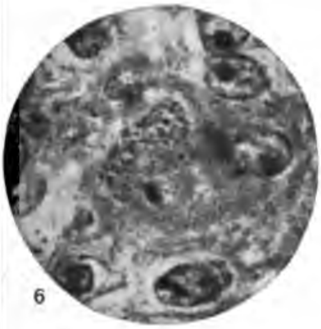
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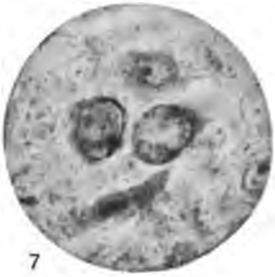
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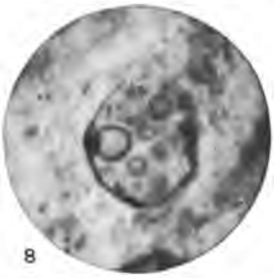
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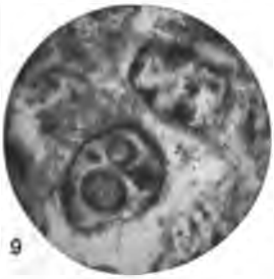
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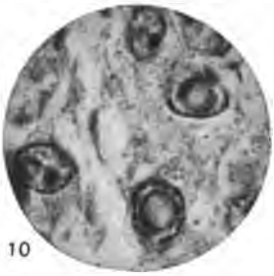
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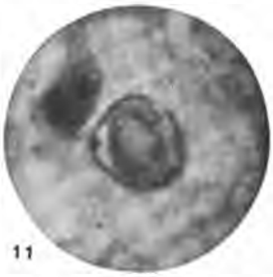
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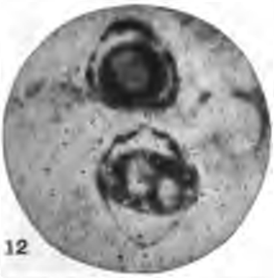
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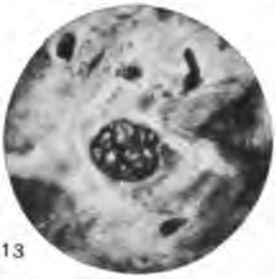
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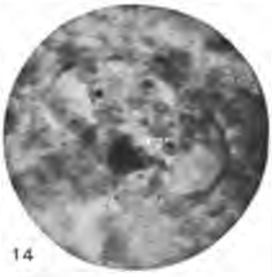
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marked. Ben Jonson, the Elizabethan dramatist, wrote:

> Envious and foule disease, could there not be,
> One beautie in an age and free from thee.

Not only did the disease destroy life, disfigure and maim, but it was at one time the most common cause of blindness. The early records of the London Asylum for the Indigent Blind showed that two-thirds of the inmates had lost their sight as a result of smallpox.

Smallpox was a great scourge before the introduction of vaccination. In London during the 18th century it caused one-twelfth of all deaths. Everyone felt that he had to pass through an attack of smallpox at some period of his life. One of Horace Walpole's correspondents (Wampole's 'Letters') wrote: «Poetry is as universally contagious as smallpox: Everyone catches it once in a life time at least, and the sooner the better.» The Germans had a proverb which expressed the same thought: «From love and smallpox but few remain free.» Most children in London contracted smallpox before the age of seven.

Symptoms.— The patient during the early stages of a classic attack of smallpox suffers from a pronounced chill, followed by sudden fever and severe backache; nausea and vomiting occur with great frequency, and the latter may persist for several days. Dizziness and general aches and pains are common. In severe cases, there is great weakness and prostration. During this stage, while the symptoms may be most suggestive of smallpox, no positive diagnosis can be made, as the «grip» and certain other infections may imitate the early symptoms of smallpox. Not until the eruption appears can one be absolutely sure of the nature of the disease. Many persons are commonly exposed to smallpox before the diagnosis can be definitely established.

Eruptive Stage.—About the third day of the illness the fever abates, the pains subside and the patient begins to feel that his illness is at an end. But he is woefully mistaken, for it has hardly begun. At this time the eruption makes its first appearance; it is not formidable at first sight and looks not unlike a multitude of flea-bites on the face, hands and elsewhere. Soon it spreads over the greater part of the body. From day to day the eruption undergoes a change; soon the face is covered with numerous pustules, the features are swollen beyond their normal proportions and the patient disfigured beyond recognition. The fever again rises and acquires the characteristics of blood-poison fever. The patient suffers greatly from the soreness occasioned by the multitude of pustules present, particularly those on the hands and feet. In severe cases the pustules may reach the enormous number of 30,000 to 40,000. The presence of smallpox sores in the nose and mouth causes great difficulty in breathing and great distress in swallowing.

The Plague of Boils.—At about the end of a fortnight, the patient, if he recovers, has passed through the height of the eruptive process and is led to believe that he is on the road to convalescence. Now a new plague attacks the unfortunate victim, for he begins to be the subject of boils and abscesses which may number but a half dozen or may reach a hundred or more. In a proportion of smallpox cases, which varies with the severity of the attack, one or both eyes may be damaged, with consequent impairment or loss of vision. An attack of unmodified smallpox runs its course in about five or six weeks. At its conclusion the patient exhibits on his countenance numerous disfiguring pits and scars which remain throughout his life as a sad reminder of the cruel malady through which he has passed.

Smallpox in its usual form is a terrible disease and there is an almost universal susceptibility of the human family to its infection, but there is no malady against which science possesses a surer and more complete safeguard. For that great discovery, the world is indebted to Edward Jenner. Like all other infectious diseases, smallpox varies in severity and fatality in different epidemics. One of the most virulent outbreaks occurred after the Franco-Prussian War in 1871; this became a veritable pandemic, spreading over the entire civilized world and destroying the lives of hundreds of thousands of persons. In other epidemics the type of the disease may be much less virulent and may be characterized by a lower mortality rate.

Since 1896 there has been widely prevalent in the United States a peculiarly mild type of smallpox which kills only a very small proportion of those attacked. Hundreds of thousands of such cases have occurred throughout the country. This mild type is doubtless due to the weakness of the infecting germ. Two entirely different types of smallpox have prevailed in America — one the virulent imported variety which destroys the lives of one-quarter of those whom it attacks, and the other the mild type above referred to. An interesting feature of the latter type is that it is not only mild as to mortality but also as to its contagiousness; practically it attacks only the unvaccinated, while vaccinated persons even if the vaccination dates back 30 or more years are, as a rule, protected against it. The opponents of vaccination point to this mild type of smallpox and say that the disease has lost its terrors. Those who are thoroughly familiar with the subject, however, know that neglect of vaccination may prepare a community for a death-dealing epidemic of the classic type of the disease.

Types of Smallpox.— The most malignant and fatal type of smallpox is that known as hemorrhagic or «black smallpox.» In this form, the patient is overwhelmed with the poison and succumbs to it before the characteristic eruption is enabled to appear. Instead of the usual eruption, blood spots occur on the skin and the patient dies in one, two or three days. This malignant type is more prone to occur during virulent epidemics, and appears chiefly in pregnant women, men addicted to alcohol and in those debilitated from various causes.

«Confluent smallpox» is a severe form of the disease in which the vesicles and pustules run together and cover extensive areas of the skin surface. In «discrete smallpox» the pustules are separated by areas of skin free of eruption. The mortality in this type is lower.

When an individual who has been vaccinated some years before exposure to smallpox infection contracts the disease, the course of the malady is apt to be favorably modified by the vaccination. If the vaccination be recent, he will in all human probability be immune against infection.

The Mortality of Smallpox in Vaccinated and Unvaccinated Persons.—As years pass, the protective power is prone to wane and after a number of years may become completely exhausted. In most instances, some protection is still exerted after many years. The following statistical tables of Welch (Wm. M.) and Schamberg (Jay F.), covering nearly 10,000 cases treated in the Municipal Hospital of Philadelphia between 1870 and 1904, are of interest:

	Cases	Deaths	Per cent of deaths
Vaccinated in infancy — good scars	2,718	167	6.16
Vaccinated in infancy — fair scars.	1,238	146	11.79
Vaccinated in infancy — poor scars	1,673	364	21.75
Total vaccinated cases..........	5,629	667	12.02
Unvaccinated..................	4,348	1,826	42.00
Total....................	9,977	2,503	25.08

It will be seen from this table that only 12 per cent of vaccinated persons died, as against 42 per cent of unvaccinated. It is furthermore shown that the perfection of the vaccination as indicated by the type of vaccinal scar present influences the mortality. Those with good scars representing the results of excellent vaccination had the lowest fatality rate (a little over 6 per cent).

Treatment of Smallpox.— The treatment of smallpox is eminently preventive: after the disease has once been contracted by an unvaccinated person relatively little of an effective character can be done; this consists largely in supporting the strength of the patient until the disease has run its course. The usual principles underlying the treatment of infectious fevers apply to smallpox. Special care is necessary, however, to protect the eyes from infection by frequent cleansings with mild antiseptic solutions, in order to avoid the possibility of destruction of vision.

Thorough and adequate vaccination is a complete safeguard against smallpox. Isolation of the patient, quarantine of those who have been in contact with him and disinfection of the premises after recovery are important sanitary measures. See VACCINATION.

JAY FRANK SCHAMBERG.

SMALLS, smâlz, **Robert**, American legislator, formerly a slave: b. Beaufort, S. C., 5 April 1839. He received a limited education. In the capacity of pilot he rendered valuable service to the Union cause during the Civil War and was promoted to the rank of captain therefor. During the years immediately following the war he rose to prominence in the Republican party, and became a member of the South Carolina legislature. He afterward served six terms in the National Congress. He was successively appointed collector of the port of Beaufort, S. C., from 1898.

SMALLWOOD, Charles, Canadian physician and meteorologist: b. Birmingham, England, 1812; d. Montreal, Canada, 22 Dec. 1873. He secured a medical education, removed to Canada in 1853 and engaged in the practice of medicine at Saint Martin's, Isle Jesus. He established a meteorological laboratory which was later described in the *Reports* of the Smithsonian Institution, and conducted many interesting observations, among them that of the effect of light on the action of ozone, and of the influence of electricity in plant germination, as well as discovering the activity of atmospheric electricity in the formation of snow crystals. From 1858 he was professor of meteorology at McGill University, later occupying also the chair of astronomy. Through a grant of funds from the government in 1860 he was enabled to purchase magnetic instruments and he began a series of investigations in 1861. Upon the establishment of the United States signal service system he made arrangements for connections with it in several Canadian cities. He was author of many valuable papers in the Smithsonian *Reports* and was a contributor to magazines.

SMALLWOOD, William, American soldier: b. Kent County, Md., 1732; d. Prince George County, Md., 14 Feb. 1792. He raised a battalion of Maryland troops in 1776, was elected colonel and on 10 July 1776 joined Washington. On 20 August his troops were engaged at the battle of Long Island and bore its brunt from sunrise until its close, leaving half their number on the field. At White Plains on 18 October they were again in the thickest of the fight. Smallwood was promoted brigadier-general for his gallantry. He was engaged at Fort Washington on 16 November, his command again bearing heavy losses, and in 1777 accompanied General Sullivan on his Staten Island expedition. He raised a new battalion of Maryland troops in that year and at the battle of Germantown, 4 Oct. 1777, his command retrieved the day and captured part of the enemy's camp. He was stationed at Wilmington in the winter of 1777–78, captured a British brig laden with provisions and served with Gates in his Southern campaign. He won the thanks of Congress for conduct at the battle of Camden, and was appointed major-general in 1780, but refused to serve under Baron Steuben, though he remained in the army until 1783. He was elected to Congress in 1785 and in 1785–88 was governor of Maryland.

SMALT. See COBALT.

SMALTITE, "gray cobalt," "tin-white cobalt," the chief ore of cobalt, is a tin-white to steel-gray, metallic mineral. Essentially it is cobalt diarsenide, $CoAs_2$, but nickel is usually present, and as its percentage increases the mineral graduates into chloanthite, the isomorphous nickel diarsenide. It also generally contains iron and a small amount of sulphur. It is usually massive, but crystallizes in the isometric system, the crystals showing distinct octahedral cleavage. As the orthorhombic mineral, safflorite, has the same composition, smaltite is one of the few illustrations of an isodimorphous mineral. Its hardness is 5.5 to 6; specific gravity 6.2 to 6.5; the massive mineral is thus distinguished from the softer and much heavier safflorite. Its color is tin-white to steel-gray; streak grayish-black; lustre metallic; opaque. It is easily fused to a magnetic globule which affords reactions with borax beads, for iron, cobalt and nickel. Its most noteworthy occurrences are in the silver and copper mines of Saxony, Bohemia and England.

SMART, Christopher, English poet: b. Shipbourne, Kent, 11 April 1722; d. London, 17 May 1771. He was graduated at Cambridge in 1742, but remained there as Fellow of Pembroke until 1747. His early fame as a satirist was supplemented by the accomplishment of more serious work, the most noted of which was his translation of Horace in 1756. His first volume of poems appeared in 1752, but it was not until a half century after his death that he won the distinction for original work in the larger world of letters which still attaches to his name. His ‹Song to David,› published in 1763, and written, it is said, upon the walls of his cell during his confinement for debt in a house of detention for such offenders, was at first deemed odd and melancholy. In 1820 it was reprinted in the *London Magazine,* and hailed by Rossetti and others as the greatest poem of the 18th century. Consult Browning, ‹Parleyings with Certain People of Importance.› See SONG TO DAVID.

SMART, William, Scotch political economist: b. Renfrewshire, 10 April 1853; d. 1915. He was graduated at the University of Glasgow and entered upon a business career. In 1884 he began to write upon economic subjects, and two years later received a lectureship at the College of Dundee; from 1896–1915 he held the Adam Smith professorship at the University of Glasgow, and is widely known as the English translator of Bohm-Bawerk's ‹Positive Theory of Capital› (1891), and as the editor of Wieser's ‹Natural Value› (1893). He is the author of ‹Studies in Economics› (1895); ‹The Distribution of Income› (1899); and ‹Taxation of Land Values and the Single Tax› (1900).

SMART-WEED, or WATER-PEPPER, glabrate, annual herbs (*Persicaria hydropiper,* and other species of the same genus), of the buckwheat family, naturalized from Europe, and found in wet places. They have alternate, lanceolate leaves, with cylindric fringed ocreæ, and panicled racemes of small flowers with greenish calyx. They also have a juice which is not only acrid to the taste, but will inflame tender skin, and has diuretic and, possibly, other medicinal properties.

SMEATON, smē'tȯn, **John,** English civil engineer: b. Austhorpe, near Leeds, Yorkshire, 8 June 1724; d. there, 28 Oct. 1792. His father was an attorney, and took him to London in 1742, where he attended the courts in Westminster Hall; but after discovering his son's disinclination to the profession he yielded, and in 1751 Smeaton began a course of experiments on a machine of his own invention, to measure a ship's way at sea, and made two voyages with Dr. Knight to try the effect of it, and also for the purpose of making experiments on a compass of his own construction, which was rendered magnetic by Dr. Knight's artificial magnet. In 1753 he was elected a Fellow of the Royal Society. In 1755 the Eddystone lighthouse was burned down, and Smeaton was entrusted with the task of rebuilding it. Operations were begun in August 1756 and completed in October 1759. It stood until 1882, when it was replaced by a new structure. In the year in which the lighthouse was finished he was awarded the Copley medal of the Royal Society. After this Smeaton was employed on many works of great public utility. He made the river Calder (in Yorkshire) navigable; planned and executed the Forth and Clyde Canal in Scotland, constituting a waterway for traffic passing between the Atlantic and the German Ocean. He was appointed engineer to Ramsgate Harbor, and improved it by various operations, of which he published an account in 1791. He built a steam-engine at Austhorpe, and made experiments with it to ascertain the power of Newcomen's engine, which he brought to a greater degree of perfection, both in its construction and powers. During many years of his life he was a frequent attendant upon Parliament, where his opinion on various works begun or projected was continually asked. Smeaton spent much of his leisure in the study of astronomy, for which purpose he fitted up an observatory in his house. Consult his ‹Reports› (1797); Smiles, ‹Lives of the Engineers› (1861).

SMEDLEY, William Thomas, American painter: b. Chester County, Pa., 26 March 1858. He was taught engraving in Philadelphia and painting in the Pennsylvania Academy of Fine Arts. He subsequently studied in New York and in Paris under Jean Paul Laurens. Opening a studio in New York in 1880 he became much sought after as an illustrator of books and periodicals. In 1882 he traveled with the Marquis of Lorne through Western and Northwest Canada to obtain drawings for illustrating ‹Picturesque Canada.› He made a sketching tour around the world in 1890. His work is distinguished by remarkable purity of line, delicacy and power of dramatic expression. Among his oil paintings may be mentioned ‹An Indiscreet Question›; ‹A Thanksgiving Dinner›; and ‹A Summer Occupation.›

SMELL. See SENSES.

SMELLIE, smĕl'ĭ, **William,** Scottish author and naturalist: b. Edinburgh, 1740; d. there, 24 June 1795. His earliest important work was the compiling of a large part of the first edition of the ‹Encyclopædia Britannica,› published in 1771. Six years earlier he had gained some prominence in the field of natural history by a ‹Dissertation on the Sexes in Plants,› in which he opposed the teachings of Linnæus, and in 1780 he published the first part of his translations of Buffon's ‹Natural History.› In 1790 his own contributions to the subject were edited and published under the title ‹Philosophy of Natural History.› He was also the author of many other works; among them were biographies of Hume, Adam Smith and other prominent Englishmen.

SMELT, a genus (*Osmerus*) of fishes of the family *Argentinidæ* and closely related to the *Salmonidæ.* The body is slender and somewhat compressed; the eyes large and round and the under jaw projecting. The American smelt (*O. mordax*) is 10 to 11 inches long; the head and body are semi-transparent, with the most brilliant tints of green and silver. It has a strong odor, by many compared to that of violets. It inhabits the sea-coast from the Gulf of Saint Lawrence to Virginia as well as the depths of those lakes, such as Champlain and Memphremagog, which have a sandy bottom, and in the winter and early spring ascends rivers in great multitudes, for the purpose of depositing its spawn. It is highly esteemed as food owing to its delicate flavor. The smelt fishery is one of considerable and growing importance and is carried on by means of nets and lines during the winter months. Some of the land-locked varieties in the lakes of Maine are said to excel even the marine fish in flavor. The European smelt (*O. eperlanus*) is scarcely distinguishable from the American and is the object of an important fishery. The surf smelt (*Hypomesus pretiosus*) is a related fish about a foot in length, found abundantly on the coasts of California and Oregon and is said to be deliciously flavored. A species of cisco or whitefish (*Argyrosomus osmeriforms*), found in the lakes of central New York, is there known as the smelt, which fish it resembles superficially in form and size.

SMELTING. See BLAST FURNACE.

SMERDIS, smėr'dĭs, the Greek name of the brother of Cambyses, king of Persia. In Persian inscriptions he is known as Bardija. He incurred the envy of Cambyses who was warned in a dream that Smerdis should take from him the throne and was, by the king's command, secretly assassinated. His name was taken by one of the Magi, Gaumata, who won the favor of the people and occupied the throne for seven months. Gaumata in 521 B.C. was recognized by Darius as an impostor and usurper and consequently put to death.

SMET, Peter John de. See DE SMET, PETER JOHN.

SMETANA, smĕ-tä'nä, **Frederick,** Bohemian composer: b. Leitomischl, Bohemia, 2 March 1824; d. Prague, 12 May 1884. He was a well-known orchestral leader in Austria and Sweden and was the composer of numerous symphonies and other operatic works. Among them are 'Die Brandenburger in Böhmen' (1866); 'Richard III'; 'Mein Vaterland'; 'Triumph-symphonie' (1853).

SMETHWICK, smeth'ĭk, England, a borough in Staffordshire, three miles west of Birmingham. It has many machine shops, rivet, screw and tube works, chemical and glass-works, iron foundries, etc. It is governed by a mayor, aldermen and council. Within its borders lies the ancient village of Domesday. Pop. about 70,694.

SMILAX, a liliaceous genus, with entire or lobed leaves, often coriaceous and shining, and greenish, diœcious, six-merous flowers with recurved perianth. The pedicels are gathered in axillary umbels, on long peduncles, and bear red, purple or black berries. They have stout, long, tuberous rootstocks and woody or herbaceous stems that are usually twining and often climbing by tendrils, which are two stipules arising from the sheaths of the petioles. *S. pseudoclima, S. rotundifolia* and others, are the familiar green or cat-briers, that twist themselves into impenetrable thickets, and are, moreover, well armed with vicious, strong prickles; they are interesting in winter, however, on account of their long-lingering leaves and bunches of berries. The American carrion-flower (*S. herbacea*) has an annual stem that is very artistic in young growth, but the tassels of bloom when open in early spring have an insupportable putrid odor. The rootstocks furnish medicines in several countries; those of several South American species yield china root and sarsaparilla (q.v.).

The smilax used for decoration by florists is an entirely different plant (*Myrsiphyllum asparagoides*) raised under glass.

SMILES, Samuel, Scottish writer: b. Haddington, 23 Dec. 1812; d. London, 17 April 1904. He was educated for the medical profession and practised for some years as a surgeon at Leeds, when he became editor of the *Leeds Times*. In 1845 he became secretary to the Leeds and Thirsk Railway, and in 1854 to the South-Eastern Railway, from which post he retired in 1866. He is the author of many works on industrial enterprise and other themes, the chief of which are 'Life of George Stephenson' (1857); 'Self-Help' (1859), which attained a very wide circulation and is the work by which he is best known; 'Workmen's Earnings, Strikes and Wages' (1861); 'Lives of the Engineers' (1861 and 1875); 'Industrial Biography' (1863); 'Lives of Boulton and Watt' (1865); 'The Huguenots, their Settlements, Churches, and Industries in England and Ireland' (1867); 'Character' (1871); 'The Huguenots in France after the Revocation of the Edict of Nantes' (1874); 'Thrift' (1875); 'Lives of Thomas Edward' (1876); 'Robert Dick' (1878); 'George Moore, Merchant and Philanthropist' (1878); 'Self-Effort' (1889); 'Jasmin, the Barber-Poet' (1891); and 'Josiah Wedgwood' (1894).

SMILEY, smī'lĭ, **Albert Keith,** American humanitarian of Quaker descent: b. Vassalboro, Me., 17 March 1828; d. 2 Feb. 1912. He was graduated at Haverford College in 1849 and was instructor there until 1853. He was engaged as a school principal in 1853–79. In 1869, with his twin-brother, Alfred, he purchased a tract of land at Lake Mohonk, Ulster County, N. Y., and in 1870 erected a summer hotel there. The holdings of the estate were gradually increased until they numbered about 5,500 acres. From 1879 Smiley was a member of the United States Board of Indian Commissioners, and from 1882 until 1904 he annually invited to Lake Mohonk as his personal guests for four days more than 200 persons for the purpose of discussing American Indian affairs. After 1904 the affairs of the dependent peoples of the Philippines, Porto Rico and Hawaii were also discussed. From 1894 he held annual conferences in the interests of international arbitration, to which were invited more than 300 persons, also his personal guests. With his brother Alfred he in 1889 purchased another large tract of land at Redlands, Cal., which he made into a park known as the Cañon Crest Park, which is kept open to the public. He presented a library costing $71,000 to Redlands. He was a member of the board of trustees of Brown University from 1875, and was an original member of the board of trustees at Bryn Mawr College.

SMILEY, Daniel, American humanitarian, half-brother of A. K. Smiley (q.v.): b. Vassalboro, Me., 29 Nov. 1855. He was graduated at Haverford College in 1878 and until 1881 was engaged in teaching Latin and Greek at the William Penn Charter School, Philadelphia. He assisted his brother Albert with the management of the Lake Mohonk summer resort, and from 1882 was connected with the management of the conferences held there. He became owner of both the Lake Mohonk estate and that at Cañon Crest Park, Redlands, Cal., upon the death of his brother in 1912. He is a trustee of Haverhill and Vassar colleges, and of the State Normal School at New Paltz, N. Y. He succeeded his brother on the United States Board of Indian Commissioners in 1912.

SMILEY, Sarah Frances, American author: b. Vassalboro, Me., 30 March 1830. She is well known as a religious speaker and writer, is a Biblical scholar and linguist and is the founder and director of the Society for Home Study of the Holy Scriptures and Church History. She has published ‘Who is He?’ (1868); ‘Fulness of Blessing’ (1876); ‘Garden Graith’ (1880), etc.

SMILLIE, smĭ'lĭ, **George Henry,** American painter: b. New York, 29 Dec. 1840. He traveled and studied his profession in Europe and America and many of his works, chiefly landscapes, are to be seen in public and private galleries, American and European, notably ‘Autumn Afternoon,’ Metropolitan Museum; ‘Near Ridgefield, Conn.,’ Lotos Club, New York City; ‘Light and Shadow Along Shore,’ Union League Club, Philadelphia; ‘On the Merrimack River,’ ‘Near Newburyport’ and ‘At Marblehead Neck,’ London, England. He was a member and for four years treasurer of the American Water Color Society; in 1882 he became a National Academician and was recording secretary and councilman for 10 years of the Academy.

SMILLIE, James D., American painter: b. New York, 16 Jan. 1833; d. 1909. Before becoming a painter he made his reputation as a landscape engraver. He was one of the founders of the American Water Color Society and one of the «original fellows» of the Painter-Etcher Society of London, England. In 1876 he became a National Academician. He served a term as president of the New York Etching Club, and is well known for his writings on etching.

SMIRKE, smérk, **Robert,** English painter: b. near Carlisle, in 1751; d. London, 5 Jan. 1845. He was originally employed in painting coach panels, but soon proved himself capable of excelling in a much higher branch of the art; and before the appearance of Wilkie had no great rival as a genre painter. He was elected a member of the Royal Academy in 1792, the year when Sir Joshua Reynolds died, and gave as his presentation picture ‘Don Quixote and Sancho.’ A large proportion of his pictures are admirable illustrations of the creation of Cervantes' pen. Among others may be mentioned Sancho's ‘Audience of the Duchess,’ ‘Don Quixote addressing his Princess Dulcinea,’ and the ‘Combat between Don Quixote and the Giants interrupted by the Innkeeper.’ Among his other works a first place is due to his ‘Infant Bacchus,’ ‘Psyche,’ the ‘Angel Justifying Providence,’ from Parnell's ‘Hermit’; the ‘Gipsy,’ and the ‘Fortune-tellers.’

SMITH, the most common family name. In the early history of the world's industry every worker in metals or every one who ran a forge was called a smith. If he worked silver or lead he was a whitesmith, if gold a goldsmith and if iron a blacksmith. In course of time John, the smith, came to be known as John Smith, Hans as Hans Schmidt, and so on. Metal working being common, Smiths became numerous, and now every directory has pages of Smiths.

SMITH, Adam, Scottish economist and philosopher: b. Kirkcaldy, Fifeshire, 5 June 1723; d. Edinburgh, 17 July 1790. He studied at the University of Glasgow, where he remained until 1740, when he went to Balliol College, Oxford. Quitting Oxford, and all views to the Church, which had led him there, in 1748 he settled at Edinburgh, and delivered some courses of lectures on rhetoric and polite literature. In 1751 he was elected professor of logic at Glasgow, and the year following of moral philosophy at the same university. Both in matter and manner his lectures were of the highest merit. Those on moral philosophy contained the rudiments of two of his most celebrated publications, of which the first, the ‘Theory of Moral Sentiments,’ appeared in 1759, and was most favorably received. His theory makes sympathy the foundation of all our moral sentiments. To this work he afterward added an ‘Essay on the Origin of Languages’; and the elegance and acuteness displayed in these treatises introduced him to the notice of several eminent persons, and he was engaged in 1764 to attend the duke of Buccleuch in his travels. A long residence in France with this nobleman introduced him to the acquaintance of Turgot, Quesnay, Necker, D'Alembert, Helvetius and Marmontel, to several of whom he was recommended by David Hume. He returned to Scotland in 1766, and at Kirkcaldy led a life of strict study and retirement for 10 years, the fruit of which was his celebrated ‘Inquiry into Nature and Causes of the Wealth of Nations’ (1776). This work has become a standard classic and may be deemed the formal precursor of the modern sciences of political economy. (See POLITICAL ECONOMICS). It owed something to French thinkers, but arranged the ideas derived from them in an original fashion. Its basic contention is that national progress is best secured by freedom of private initiative within the bounds of justice. Subsequently he was made commissioner of customs for Scotland, and in 1787 was chosen rector of the University of Glasgow. A short time before his death he ordered all his manuscripts to be burned, except a few detached essays. Numerous editions both of the ‘Moral Sentiments’ and the ‘Wealth of Nations’ have been published. Of the former the sixth edition contained considerable additions and corrections. This work was translated into French by the Marquis de Condorcet. A volume of additions and corrections to the first two editions of the ‘Wealth of Nations’ appeared in 1784, and was included in the third edition, published the same year. The best of the later editions of this standard work are those published under the editorship of Macculloch (with life notes and supplementary dissertations 1828; often reissued), Thorold Rogers (1870), J. S. Nicholson (1884), and Belfort Bax (1887). The ‘Wealth of Nations’ has been translated into several European languages — into French by Germain Garnier (1802; new ed., 1860); into German by Garve

(1794–96), and by Asher (Stuttgart 1861). (See WEALTH OF NATIONS, THE). Consult Stewart, 'Life of Adam Smith' (4th ed., 1843); Mackintosh, 'Progress of Ethical Philosophy' (in Vol. I of his 'Misc. Works,' 1854); Rae, 'Life of Adam Smith' (1895); Graham, 'Scottish Men of Letters in the 18th Century' (1901).

SMITH, Sir Albert James, Canadian statesman: b. Shediac, New Brunswick, 1824; d. 1883. He was called to the bar of New Brunswick in 1847, served in the New Brunswick assembly in 1852–67, was a member of the executive council in 1856–63, attorney-general in 1862–63 and premier in 1864–66. He was elected to the Dominion Parliament in 1867, and was Minister of Marines and Fisheries in 1873–78. He was the representative of the Dominion government before the Halifax Fisheries Commission in 1877. In 1878 he was knighted.

SMITH, Albert William, American mechanical engineer: b. Westmoreland, N. Y., 30 Aug. 1856. He was graduated at Cornell University in 1878, and was assistant professor in mechanical engineering there in 1887–91. In 1891–92 he was professor of machine design at the University of Wisconsin, and in 1892–1904 he was professor of mechanical engineering at Leland Stanford Jr. University. From 1904 he was director of mechanical engineering at Sibley College, Cornell University, where since 1915 he has been dean. Author of 'Elementary Machine Design' (1895); 'Material of Machines' (1902; 2d ed., 1914), etc.

SMITH, Alexander, Scottish poet and essayist: b. Kilmarnock, 31 Dec. 1830; d. Wardie, near Granton, 5 Jan. 1867. After a general education, he learned pattern-designing and removed to Glasgow with the double object of finding employment among its manufacturers and intellectual improvement among its literary society. In 1853 he published his 'Life Drama.' It was at first enthusiastically received as a poem of the highest order, but a reaction of dissent soon set in headed by Aytoun, who in his burlesque tragedy of 'Firmilian' characterized Smith's production as belonging to the «spasmodic» school with Dobell and P. J. Bailey. In 1854 Smith was appointed secretary of the University of Edinburgh, to which the offices of registrar and secretary to the university council were later added, and the following year produced, with Sydney Dobell, a volume of 'Sonnets on the War.' This was followed in 1857 by his 'City Poems,' to which succeeded his longest and best work, 'Edwin of Deira' (1861). He turned his attention seriously to prose composition, and became a regular contributor to leading English magazines.

SMITH, Alexander, American chemist: b. Edinburgh, Scotland, 11 Sept. 1865. He was educated in Edinburgh and Munich, receiving his Ph.D. at the University of Munich. In 1889–90 he was assistant in chemistry at the University of Edinburgh; from 1890 to 1894 he held the chair of chemistry and mineralogy at Wabash College; 1898–1903, professor and director of general and physical chemistry, University of Chicago. In 1911 he was placed in charge of the department of chemistry of Columbia University. He has translated several important foreign works on chemistry, and published among others 'Laboratory Outlines of General Chemistry' (1899); 'Teaching of Chemistry and Physics' (1902); 'Introduction to General Inorganic Chemistry' (1906); 'General Chemistry tor Colleges' (1908); 'Text-Book of Elementary Chemistry' (1914).

SMITH, Alexander Coke, American Methodist bishop: b. Sumter County, S. C., 16 Sept. 1849; d. Asheville, N. C., 28 Dec. 1906. He was graduated from Wofford College, Spartanburg, S. C., in 1886, was appointed professor of mental and moral philosophy there and in 1890 was called to the chair of theology at Vanderbilt University. He was elected bishop of the Methodist Episcopal Church South in May 1902.

SMITH, Alfred E., American legislator and statesman: b. New York City, 30 Dec. 1873. He attended the parochial school of Saint James in New York and after graduation took charge of the trucking business of his father. In 1895 Mr. Smith was appointed clerk in the office of the commissioner of jurors, which position he held until his election to the State assembly in 1903 from the then second district of New York City. Re-elected annually to the assembly, he rapidly rose to leadership in that body; in 1911 he became Democratic leader in the assembly; in 1912 was Democratic floor leader; and in 1913 was the unanimous choice of his party for speaker. Mr. Smith was re-elected to the assembly in 1913 and 1914, and in the spring of 1915 was chosen a delegate to the New York State Constitutional Convention. In this capacity he received high commendation from all parties, and Elihu Root, chairman of the convention, pronounced him one of the best informed in the State government within that body. In the assembly Mr. Smith demonstrated unusual ability. During his term of service the insurance investigation had occurred, with its important effect upon the future of State government; the Alds scandal was largely responsible for the election of Governor Dix; the factory investigation had taken place with Mr. Smith as one of the most active members of the committee. Its findings culminated in the enactment by the Democratic party while in power of the greatest number of humanitarian laws ever placed on the statute books of New York in a single decade. The struggle for and the passage of the Workmen's Compensation Law took place while Mr. Smith was a member of the legislature, as also the great fight for political purity, the elimination of graft and of corporation campaign contributions, resulting in the passage of the Direct Primary Law and the imposition of rigorous penalties for corrupt practices in connection with elections. During Mr. Smith's term of service in the State legislature he constantly fought for the submission of woman suffrage to the people. In 1915 Mr. Smith was elected sheriff of New York County by a plurality of 46,202. In 1917 he was elected president of the board of aldermen of Greater New York. In each office that he held he received the unqualified praise and support of the best element of the press and public regardless of politics. His record made him the logical candidate of his party for governor in 1918. At the election of 5 Nov. 1918 he was elected governor of New

York, carrying Greater New York by the largest plurality ever given a gubernatorial candidate. In the State he received 1,009,936 votes against 994,828 for his opponent, Mr. Whitman. One of his first acts as governor was to appoint a reconstruction commission to deal with the great after-war problems. Among his recommendations to the legislature of 1919 were a speedy settlement of pressing problems resulting from the war; the necessity of providing for at least optional municipal ownership of public utilities; providing more liberal home rule for cities; providing a minimum wage for women; the passage of health insurance measures for industrial workers; the amendment of the Workmen's Compensation Law for the purpose of eliminating the direct settlement clause; and the establishment of co-operative conditions between the producer and the consumer. He was able to secure the enactment of several of these recommendations, but many of his remedial measures met defeat in the legislature. The governor allowed liberal appropriations for highway maintenance and repair, and signed the bill providing for equal pay for men and women employed in the school system of the State. Appropriations for the caring of the insane and the feeble-minded during his first year were the largest in the history of the State. In June 1919 he called a special session of the legislature for the purpose of ratifying the woman suffrage amendment to the Federal Constitution.

SMITH, Alfred Holland, American railroad president: b. 1864. He became a messenger boy with the Lake Shore and Michigan Southern Railroad in 1879, was made division superintendent in 1890, assistant superintendent in 1901 and in 1901–02 he was general superintendent of the road. He then became associated with the New York Central Railroad, was its general superintendent in 1902–03, general manager in 1903–12, vice-president in 1906–13, and on 1 Jan. 1914 he was made president of that railroad and its subsidiary lines. He was appointed assistant director-general of railroads by Secretary McAdoo, 29 Dec. 1917, in charge of transportation east of Chicago and north of the Ohio and Potomac rivers; and on 18 Jan. 1918 regional director of Eastern railroads.

SMITH, Andrew Jackson, American army officer: b. Bucks County, Pa., 28 April 1815; d. Saint Louis, Mo., 30 Jan. 1897. He was graduated from the United States Military Academy in 1838, and prior to the Civil War was stationed at various army posts on the Western frontier. In 1861 he was promoted to the rank of colonel in command of the second California Cavalry, and in 1862 brigadier-general of volunteers and chief of cavalry of the Department of the Missouri. He took part in the siege of Corinth and was also engaged in the campaigns of Vicksburg and Mobile. In 1866 he was restored to the rank of colonel in the regular army, but three years later resigned and accepted the appointment of postmaster of Saint Louis. Ten years later he was again made an officer in the United States army, and placed upon the retired list.

SMITH, Archibald Carey, American naval architect and marine painter: b. New York, 4 Sept. 1837; d. 8 Dec. 1911. He received a grammar school education, studied marine painting under M. F. H. de Haas, and learned the boat-building trade under Robert Fish. In 1860 he built the American sloop *Comet,* which held the American championship for several years. He built the first iron boat in the United States, the yacht *Vindex,* after which he abandoned painting to devote himself entirely to boat designing and building. He built the yacht *Mischief,* also constructed of iron, and the successful defender of the *America's* Cup against the *Atalanta* in 1881. He designed the schooners *Iroquois, Elsemarie, Enchantress* — winner of the King's Cup; many yachts, among them the *Meteor* for the German emperor; motor boats and steamboats.

SMITH, Benjamin Bosworth, American Protestant Episopal bishop: b. Bristol, L. I., 13 June 1794; d. New York, 31 May 1884. He was graduated from Brown University in 1816, took orders in 1818, and in 1820–23 had charge of various churches in Virginia. He was rector of Saint Stephen's Church, Middlebury, Vt., in 1823–28, and from 1830 to 1837 rector of Christ Church, Lexington, Ky. He was consecrated first bishop of Kentucky in 1832, and on the death of Bishop Hopkins in 1868 he became presiding bishop of the Episcopal Church in the United States. He published 'Saturday Evening, or Thoughts on the Progress of the Plan of Salvation' (1876), etc.

SMITH, Benjamin Eli, American editor: b. Beirut, Syria, 7 Feb. 1857; d. 1913. He was graduated from Amherst College in 1877, and has been editor of the 'Century Dictionary'; 'Century Cyclopedia of Names'; and 'Century Atlas.' He has translated Schwegler's 'History of Philosophy' (1879); Cicero's 'De Amicitia,' 'Lælius' (1897); and edited Franklin's 'Poor Richard's Almanac' (1898).

SMITH, Benjamin Leigh, English Arctic explorer: b. 12 March 1828. He was educated at Cambridge, and was called to the bar in 1856. After acquiring a fortune he became interested in Arctic exploration and made his first voyage in the yacht *Samson* in 1871, returning with important acquisition of facts regarding Spitzbergen, where he had penetrated to lat. 81° 24'. He made a second and third expedition to Spitzbergen in 1872–73. By his deep-sea observations he established the fact of warm undercurrents flowing beneath the surface water of the Gulf Stream. In 1880–81 on the steamer *Eira* he made two trips, the first resulting in important discoveries on and in the neighborhood of Franz-Josef Land. On the second expedition, the *Eira* was crushed in the ice and sunk 21 Aug. 1881 off Cape Flora. After wintering in that region the crew reached Nova Zembla in August 1882, and were brought home by a relief expedition. He received gold medals from the Paris Geographical Society in 1880 and from Royal Geographical Society in 1881.

SMITH, Buckingham, American historian and philologist: b. Cumberland Island, Ga., 31 Oct. 1810; d. New York, 5 Jan. 1871. He was graduated from the Harvard Law School in 1836, and for several years practised in the courts of Maine, when he took up his residence in Florida. His knowledge of the Mexican language and collections of Indian manuscripts and other relics were acquired during his office as secretary of the United States legation in

Mexico in 1850–52. In 1855–58 he served in a similar capacity the legation at Madrid, and there gathered material of much value regarding the history of the Spanish-American colonies. Among his most important works are ‘Narrative of Hernando de Soto’ (1854); ‘A Grammatical Sketch of the Heve Language’ (1861); ‘A Grammar of the Pima or Nérome’ (1862); ‘An Enquiry into the Authenticity of Documents Concerning the Discovery of North America by Verrazzano’ (1864).

SMITH, Charles Alphonso, author, educator: b. in Greensboro, N. C., 28 May 1864; now resides at Charlottesville, Va. In 1884 he was graduated from Davidson College, North Carolina, and later pursued graduate work in Johns Hopkins University, where from 1890 to 1893 he was instructor in English. From 1893 to 1902 he was professor of English in Louisiana State University; from 1902 to 1909 professor of English and dean of the graduate department, University of North Carolina. In 1909 he was elected professor of English literature in the University of Virginia, and about the same time was appointed (for 1909–10) Theodore Roosevelt professor of American history and institutions in the University of Berlin. He has written several authoritative works on English grammar, among them ‘Old English Grammar and Exercise Book’ (1896); ‘Elementary English Grammar’ (1903), and ‘Studies in English Syntax’ (1906). He served as associate editor of ‘The World's Orators’ (1901), and of the ‘Library of Southern Literature’ (1909).

SMITH, Charles Emory, American journalist: b. Mansfield, Conn., Feb. 1842; d. Philadelphia, Pa., January 1908. He was graduated from Union College in 1861, and five years later became the editor of the Albany *Express*. His connection with the Philadelphia *Press* dates from 1880, when he was made its editor-in-chief. This office he resigned in 1890 to become Minister to Russia. In 1898 he was appointed Postmaster-General of the United States and continued in the Cabinet until 1901, when he resigned. In 1902 he again assumed the editorship of the Philadelphia *Press*.

SMITH, Charles Ferguson, American soldier: b. Philadelphia, Pa., 24 April 1807; d. Savannah, Tenn., 25 April 1862. He was graduated at West Point in 1825 and served there as instructor in tactics and as adjutant and commandant 1829–45. He commanded a light battalion in the Mexican War and won distinction in several actions. He subsequently commanded the Red River expedition, served in the Utah expedition and at the beginning of the Civil War was made brigadier-general of volunteers in the Union army. In 1862 he was active in the battle of Fort Donelson and was promoted to major-general of volunteers.

SMITH, Charles Forster, American classical scholar and educator: b. Abbeyville County, S. C., 30 June 1852. He was graduated at Wofford College in 1872, later studied at the universities of Harvard and Berlin, and took his Ph. D. at the University of Leipzig in 1881. In 1875–79 he was professor of classics and German at Wofford College, and in 1881–82 professor of Greek and Latin at Williams College. He occupied the chair of modern languages at Vanderbilt University in 1882–83, and that of Greek in 1883–94. Since 1894 he has been professor of Greek and classical philology at the University of Wisconsin. He was president of the American Philological Association in 1903. He translated Hertzberg's ‘History of Greece’ (1900); edited several volumes of the classics and contributed to the philological journals and literary reviews. Author of ‘Reminiscences and Sketches’ (1909).

SMITH, Charles Henry, «Bill Arp,» American humorist: b. Lawrenceville, Ga., 15 June 1826; d. Atlanta, Ga., 24 Aug. 1903. He was graduated at Franklin College, Georgia, 1848, practised law, first at Rome, Ga., and then at Cartersville, and served in the Confederate army throughout the Civil War, becoming major on the staff of the Third Georgia brigade. He was a State senator 1866–68, and was well known as the author of the «Bill Arp» letters, contributed to the Atlanta *Constitution* and to ‘Home and Farm’ of Louisville, Ky. He published ‘Bill Arp's Letters’ (1886); ‘Bill Arp's Scrap Book’; ‘A Side Show of the Southern Side of the War’; ‘Fireside Sketches’ (1890); ‘Georgia as Colony and State, 1733–1893’ (1890); ‘The Uncivil War from 1861 to Date.’

SMITH, Clement Lawrence, American Latin scholar and educator: b. Upper Darby, Pa., 13 April 1844; d. 1 July 1909. He was graduated at Haverford College in 1860 and at Harvard University in 1863, later studying at Göttingen University. He was professor of Latin and Greek at Swarthmore College in 1869–70; was assistant professor of Latin at Harvard in 1883–1904, professor in 1883–1904, dean in 1882–1901 and dean of the faculty of arts and sciences in 1898–1902. He was director of the American School of Classical Sciences at Rome, Italy, in 1897–98. He edited the ‘Odes and Epodes of Horace’ (1894) in the ‘College Series of Latin Authors.’

SMITH, David, American naval officer: b. Scotland, 1834; d. Washington, D. C., 29 May 1903. Having been brought to America in childhood, he received his education at the Andover Academy and at Harvard University. Just before the outbreak of the Civil War he entered the Engineer Corps of the United States navy and took part in many of its later operations. He originated the idea of ventilating warships by the exhaust method, but was more widely known for his invention of an apparatus for testing instruments of precision used in engineering. He was promoted rear-admiral and retired in 1896, but took part in the Cuban War.

SMITH, David Eugene, American mathematician and educator: b. Cortlandt, N. Y., 21 Jan. 1860. He was graduated at Syracuse University in 1881 and took his Ph.D. there in 1887. He was master of pedagogics at the Michigan State Normal College in 1891–98; principal of the State Normal School, Brockport, N. Y., in 1898–1901, and has since been professor of mathematics at Teachers' College, Columbia University. He is editor of the *Bulletin* of the American Mathematical Society, and a contributor to other mathematical periodicals. He edited De Morgan's ‘Budget of Paradoxes’; is joint author with G. Wentworth and with W. W. Brennan of a number of textbooks; joint author of ‘A History of Japanese

Mathematics’ (1914); joint translator of Klein's ‘Famous Problems of Geometry’; and of Fink's ‘History of Mathematics’; and author of ‘The Teaching of Arithmetic’ (1909); ‘The Teaching of Geometry’ (1912); ‘Rara Arithmetica’ (1907); ‘Topical Practical Arithmetic’ (1912), etc.

SMITH, David M., American inventor: b. Hartland, Vt., 1809; d. Springfield, Vt., 10 Nov. 1881. His first patent was secured in 1832, and he began the manufacture of "awls on the haft." This awl haft was similar to the one now known as the Aiken awl. He removed to Springfield after representing the town of Gilsum in the New Hampshire legislature for 1840–41. In 1849 he patented in America and England a combination lock that could not be picked. Among his other patents were an improvement on the first iron lathe-dog, a pig-splitting machine, two sewing machines, a patent clothespin, a spring hook and eye and a blanket hook. In all he secured about 60 patents, including newspaper folding machinery.

SMITH, Edgar Fahs, American chemist and educator: b. York, Pa., 23 May 1856. He was graduated at Pennsylvania College in 1874 and took his Ph.D. at the University of Göttingen in 1876. He was professor of chemistry at the University of Pennsylvania in 1888–1911, vice-provost there in 1899–1911, and has since been provost. He has made important investigations in electrolytic methods of analysis and atomic weight determinations. He is a member of the National Academy of Sciences, was president of the American Chemical Society in 1898, and of the American Philosophical Society in 1902–06. He translated Richter's ‘Inorganic Chemistry’ (3d ed., 1900), and is author of ‘Electro-Chemical Analysis’ (new ed., 1918); ‘Theories of Chemistry’ (1913); ‘Chemistry in America’ (1914); ‘Atomic Weights’ (1915); ‘James Woodhouse’ (1918), etc.

SMITH, Edmund Kirby, American soldier: b. Saint Augustine, Fla., 16 May 1824; d. Sewanee, Tenn., 28 March 1893. He was graduated at West Point in 1845, and entered the Mexican campaign as second lieutenant in the Fifth Infantry. He fought at Palo Alto, Resaca de la Palma and Monterey, was brevetted first lieutenant for bravery at Vera Cruz and Cerro Gordo and captain for gallantry at Conteras. During 1849–52 he taught mathematics at West Point. In 1855 he was appointed captain in the second Cavalry, and later engaged in Indian campaigns, reaching the rank of major. He resigned his commission when Florida seceded. In 1861 he was commissioned colonel in the Confederate army, and in the same year was made brigadier-general. Early in the war he served under Gen. J. E. Johnston, and was severely wounded at Bull Run, 21 July 1861. In 1862, having been made major-general, he commanded the Confederate forces in the Cumberland Gap region, led the advance of Bragg's army in the Kentucky campaign, and on 30 August defeated the Federal troops under General Nelson near Richmond, Ky. His plan included an attack upon Cincinnati, but he withdrew toward Frankfort when Bragg failed to come to his support. He was raised to the rank of lieutenant-general, and took part in the battles of Perryville and Stone River (q.v.) In 1863 he was placed in command of the department west of the Mississippi, organized the governments of Louisiana, Arkansas, Texas and Indian Territory, and established a vigorous foreign trade by successfully running the blockade at Galveston. In 1864 he operated against Banks in the Red River campaign, and he was the last Confederate general to surrender (26 May 1865). He was president of the Pacific and Atlantic Telegraph Company 1866–68, president of the Western Military Academy 1868–70, chancellor of the University of Nashville 1870–75 and professor of mathematics in the University of the South, Sewanee, Tenn., from 1875 until his death.

SMITH, Elizabeth Oakes (Prince), American author, wife of Seba Smith: b. near Portland, Me., 12 Aug. 1806; d. Hollywood, S. C., 15 Nov. 1893. She was an occasional contributor to the press for nearly 50 years, and was one of the first women to speak upon the lecture platform, from which she advocated equal suffrage for women and other reforms. Her first volume of verse, collected from the periodicals, was published in 1838 under the title ‘Riches Without Wings.’ Her other books which had also a short-lived popularity, include ‘The Sinless Child and Other Poems’ (1843); ‘Stories for Children’ (1847); ‘Woman and Her Needs’ (1851), and ‘Jacob Feisler,’ a drama (1853).

SMITH, Eli, American Protestant missionary and scholar: b. Northford, Conn., 13 Sept. 1801; d. Beirut, Syria, 11 Jan. 1857. He was graduated at Yale in 1821 and at Andover Theological Seminary in 1826. He was ordained that year, and went to Malta to take charge of a missionary printing establishment. He was later connected with the Syrian mission and traveled through Greece, Armenia, Georgia and Persia, with Dr. H. G. O. Dwight, the journey and its reports resulting in the establishment of the Armenian and Nestorian missions. From 1833 he was stationed at Beirut, and in 1838 and 1852 he made lengthy journeys in Palestine. He was thoroughly versed in Arabic, and materially assisted in the production of an improved form and font of Arabic type. He made a lifework of his translation of the Bible into Arabic, and when he died had completed translations of the New Testament, the Pentateuch, and part of the prophetical books. The work was finished by Dr. C. V. Van Dyke (New York 1866–67). He was joint author of ‘Missionary Researches in Armenia’ (2 vols., 1833).

SMITH, Ellison DuRant, American senator: b. Lynchburg, S. C., 1 Aug. 1866. He was graduated at Wofford College in 1889 and subsequently interested himself in cotton planting. He took an active part in securing improved methods in cotton growing, organized the Farmers' Protective Association, and was instrumental in securing the Boll Weevil Convention at Shreveport, La., in 1905, becoming field agent of the Southern Cotton Growers' Association, which was the outgrowth of the convention. He served in Congress in 1896–1900 and was elected to the United States Senate in 1908 and in 1914.

SMITH, Erminnie Adelle Platt, American ethnologist: b. Marcellus, N. Y., 26 April 1836; d. Jersey City, N. J., 9 June 1886. She was educated at Willard Seminary in Troy, but continued her studies abroad some years later, and during a residence in Germany was graduated from the School of Mines at Freiburg. In 1878 she was engaged by the Smithsonian Institution to make a study of the languages and customs of the Iroquois Indians, and devoted the remainder of her life to the investigation of that subject. In order that she might gain the most intimate acquaintance with their customs and institutions she became a member of one of their tribes, the Tuscaroras, and in this way familiar with their legends and ideas and habits in general. She died while her Iroquois-English dictionary was being printed.

SMITH, Erwin Frink, American plant pathologist: b. Gilbert's Mills, N. Y., 21 Jan. 1854. He was graduated at the University of Michigan in 1886 and took his Sc.D. there in 1889. He became expert pathologist of the United States Department of Agriculture in 1889 and later had charge of the laboratory of plant pathology of the Bureau of Plant Industry. He is a member of the National Academy of Sciences, was president of the Society of American Bacteriologists in 1906 and of the Botanical Society of America in 1910. He is a trustee of the Marine Biological Laboratory at Wood's Hole, Mass. He was associate editor of the *Centralblatt für Bacteriologie;* contributed to the ‹Standard Dictionary›; is author of many scientific papers and of ‹Bacteria in Relation to Plant Diseases› (3 vols., 1905–14), etc.

SMITH, Eugene Allen, American geologist: b. Autauga County, Ala., 27 Oct. 1841. He was graduated at the State University of Alabama in 1862, later studying at the universities of Berlin, Göttingen and Heidelberg and took his Ph.D. at Heidelberg in 1868. He was an officer in the Confederate army in 1862–65 and from 1871 was professor at the University of Alabama. He became State geologist in 1873. In 1913 he served as president of the Geological Society of America.

SMITH, Francis Henney, American educator and soldier: b. Norfolk, Va., 18 Oct. 1812; d. Lexington, Va., 21 March 1890. He was graduated from West Point in 1833 and in 1834 was appointed assistant professor there, but resigned from the army in 1836 and was professor of mathematics at Hampden-Sidney College, Virginia, in 1837–39. On the organization of the Virginia Military Institute at Lexington, Va., in 1839, he was appointed superintendent, a position he occupied until January 1890, when he became professor emeritus. During the Civil War he served as colonel in the Confederate army, was in command of the fort at Craney Island, participated in the defense of Richmond in 1864 and of Lynchburg against General Hunter. After the war he at once set about the reconstruction of the institute buildings which had been destroyed by fire and resumed his duties there when it was reopened. He published various textbooks on mathematics and also wrote ‹The Best Methods of Conducting Common Schools› (1849); ‹College Reform› (1850); ‹Report to the Legislature of Virginia on Scientific Education in Europe› (1859), etc.

SMITH, Francis Hopkinson, American artist, author and engineer: b. Baltimore, Md., 23 Oct. 1838; d. 1915. Educated as a mechanical engineer, he became a contractor and planned and supervised the building of numerous important works, among them the sea-wall around Governor's Island at Tompkinsville, S. I., the Race Rock lighthouse off New London, Conn., and the foundation for the Statue of Liberty on Bedloe's Island, New York Harbor. But he is also an artist, particularly in water colors and charcoal, earning special praise for his aquarelle sketches of Venice from all viewpoints and under all conditions of atmosphere and light. Again, he is an author, best known for his genial ‹Colonel Carter of Cartersville› (1891), which was dramatized by Augustus Thomas and arranged by the author for his public readings. Other volumes by him are ‹A White Umbrella in Mexico› (1881); ‹A Day at Laguerre's› (1892); ‹Gondola Days› (1897); ‹Venice of To-day› (1897); ‹Caleb West› (1898), and ‹The Fortunes of Oliver Horn› (1903); ‹At Close Range› (1904); ‹Kennedy Square› (1911); ‹The Arm-Chair at the Inn› (1912); ‹In Dickens' London› (1914); (Felix O'Day› (1915).

SMITH, Sir Francis Pettit, English inventor: b. Hythe, England, 9 Feb. 1808; d. South Kensington, 12 Feb. 1874. From boyhood his interest in boats led him to invent many ingenious devices for their propulsion. In 1836, in entire ignorance of the inventions of Ericsson and Stevens, he constructed a model steamboat propelled by a screw below the water line. His patent for this method of propulsion was obtained six weeks before that of Ericsson. The British admiralty, in spite of the opposition of the engineering world, assisted in the experiments which resulted in the construction of a larger vessel whose trial trip in October 1839 assured the success of the new propeller and its adoption by the British navy in 1844, five years after Ericsson's construction of the first American steam warship. Consult Woodcroft, ‹Origin and Progress of Steam Navigation› (1848); Bourne, ‹Treatise on the Screw Propeller.›

SMITH, Fred B., American evangelist: b. Lone Tree, Iowa, 24 Dec. 1864. He studied at the State University of Iowa, and later engaged in evangelistic work. In 1898–1913 he was connected with the Young Men's Christian Association, in the service of which he visited the United States army in Cuba in 1898; and traveled throughout the United States in the interests of the association in 1899–1901. He became international secretary in 1910, and was a prominent worker in the «Men and Religion Forward Movement» which resulted in the establishment of more than 1,500 new branches of the association. Since 1914 he has been chairman of the Commission of the Interchurch Federation. Author of ‹Men Wanted› (1911); ‹A Man's Religion› (1913).

SMITH, Frederick Appleton, American soldier: b. Craigville, N. Y., 15 May 1849. He graduated from the United States Military Academy in 1873, became a captain in 1890, a major in 1899, a colonel in 1902 and a brigadier-general in 1908. As a young man he served in Indian outbreaks in Arizona and the Dakotas. At the breaking out of the Spanish War he was sent to Cuba, where he commanded in the district of Guanajay. After service in the Philippines he was ordered to Washington and served on the general staff revising the infantry drill regulations. Thereafter he held several posts East and West and was retired in 1913.

SMITH, Frederick M., son of Joseph Smith and grandson of the founder of the Church of Jesus Christ of Latter-Day Saints, sometimes erroneously called Mormons, was born at Plano, Ill., 21 Jan. 1874 and in 1881 moved with his parents to Lamoni, Iowa, where he grew to manhood. He attended the public schools and was graduated from the Lamoni High School. He was the first graduate of Graceland College, Lamoni, Iowa, and has taken advance work at the University of Iowa, Iowa City; the University of Kansas at Lawrence, Kan.; finishing at the Clark University at Worcester, Mass. He became affiliated with the Reorganized Church of Jesus Christ of Latter-Day Saints in his boyhood and has occupied some important offices in this organization. For a short time he filled the office of general historian of the Church by appointment and was by ordination elder, counsellor to the local bishop of Lamoni, Iowa, president of a quorum of elders and counsellor to his father, president of the church. His activities have been divided between his school and church work, but now are to be devoted more exclusively to church service. In addition to the above offices he has been a member and for a time president of the board of trustees of Graceland College. Upon the death of his father in December 1914 he, with his cousin, Elbert A. Smith, of Lamoni, were chosen by the leading authorities of the Church to preside temporarily. At the next General Conference, held in April 1915 he was chosen to permanently occupy as his father's successor in that office and received ordination to that office at Independence, Mo., 5 May 1915. His cousin was installed as his counsellor.

SMITH, George, English historian and theologian: b. Condurrow, Cornwall, 31 Aug. 1800; d. Camborne, Cornwall, 30 Aug. 1868. He was educated at the British and foreign schools at Falmouth and Plymouth and afterward engaged in the manufacturing business, in which he was notably successful. He was well known as a local preacher of the Wesleyan faith and was a student of ability. Author of ‘Religion of Ancient Britain to the Norman Conquest’ (1844; 3d ed., 1865); ‘Sacred Annals’ (3 vols., 1847–53); ‘History of Wesleyan Methodism’ (3 vols., 1857–61; 4th ed., 1865); ‘Life and Reign of David’ (1868), etc.

SMITH, George, English Assyriologist: b. London, 26 March 1840; d. Aleppo, Asiatic Turkey, 19 Aug. 1876. He was apprenticed to the engraver's trade, but became deeply interested in the Oriental explorations of Layard and Rawlinson and devoted himself in his spare time to the study of Assyrian subjects. His study at the British Museum attracted the attention of Sir Henry Rawlinson, who permitted him access to his workroom there, thus materially assisting him. His first notable achievement was the decipherment of a text fixing the date of the tribute paid to Shalmanezer by Jesu, son of Omri. He later became associated with Rawlinson in the preparation of the third volume of ‘Cuneiform Inscriptions of Western Asia,’ and in 1867 he was appointed assistant in the Assyriology department at the Museum. In 1871 he published ‘Annals of Assurbani-pol’ transliterated and translated, as well as papers on ‘The Early History of Babylonia’ and ‘The Reading of the Cypriote Inscriptions.’ His translation of the Chaldean account of the Deluge was read before the Society of Biblical Archæalogy, 3 Dec. 1872 and brought him immediate fame. Sir Edwin Arnold of the *Daily Telegraph* sent him to Nineveh in 1873 for the purpose of finding the missing tablets concerning the Deluge story. Smith secured not only these, but also found the records of the succession and duration of the Babylonian dynasties. In 1874 he returned to Nineveh under the direction of the Museum and succeeded in procuring a large number of tablets belonging to the great Solar Epic, of which the Deluge forms the 11th day, as well as other valuable fragments. He published the results of this expedition in ‘Assyrian Discoveries’ (1875); and ‘Chaldean Account of Genesis’ (1876). He set out upon his third expedition to Nineveh in March 1876, secured between 2,000 and 3,000 tablets at Bagdad, but at Kouyunjik found himself debarred from excavating owing to the unsettled condition of the country. He was stricken with fever at Ikisji and was removed to the British Consulate at Aleppo, where he died. Besides the works already mentioned he was author of ‘The Phonetic Values of Cuneiform Characters’ (1871); ‘Ancient History from the Monuments: Assyria’ (1875); ‘Ancient History from the Monuments: Babylonia’ (1877); ‘The History of Sennacherib’ (1878), etc.

SMITH, George Adam, Scottish theologian: b. Calcutta, 19 Oct. 1856. He was educated in Edinburgh at the University and at New College, studied also in Tübingen and Leipzig, was minister of Queen's Cross Free Church in 1882–92 and in 1892 was made professor of Old Testament language, literature and theology in the United Free Church College at Glasgow. In 1896 he visited the United States as Percy Turnbull lecturer on Hebrew poetry at the Johns Hopkins University and in 1899 as Lyman Beecher lecturer at Yale University. His writings in book form are ‘The Book of Isaiah’ (1888–09); ‘The Preaching of the Old Testament to the Age’ (1893); ‘Historical Geography of the Holy Land’ (1894; 7th ed., 1901); ‘The Twelve Prophets’ (1896–97); a ‘Life of Henry Drummond’ (1898; 6th ed., 1902), and ‘Modern Criticism and the Preaching of the Old Testament’ (1901).

SMITH, George Barnett, English author: b. Ovenden, near Halifax, Yorkshire, 17 May 1841. In 1864, after a secondary schooling at Halifax, he went to London, where he was employed on the staff of the *Globe* and the *Echo,* published a book of verse in 1869, and became a contributor to the leading British reviews. Among his further volumes are ‘Poets and Novelists,’ critiques (1875); ‘Shelley’ (1877); a ‘Life of Bright’ (1881); ‘Victor Hugo’ (1885); ‘William I and the German Empire’ (1887), and a work on ‘The United States’ (1896–97). He is also an amateur etcher of some ability.

SMITH, George Murray, English publisher: b. London, 19 March 1824; d. Weybridge, Surrey, 6 April 1901. He entered the counting-house of his father, senior partner of the firm of Smith, Elder and Company, India merchants and publishers, became manager of the publishing department and after his father's death assumed control of the entire business, including banking and the agency of the Overland route to India. He published the works of Charlotte Brontë, Ruskin, Darwin and Thackeray, founded the *Cornhill Magazine* in 1859 with the latter as editor and contributor, published in it George Eliot's 'Romola' and in 1865 he founded the *Pall Mall Gazette* with Frederick Greenwood as editor. The banking business was ultimately transferred to other hands, Smith, Elder and Company retaining the publishing interests and continuing to issue the works of the leading English authors. They were publishers for Robert Browning and Matthew Arnold and were granted the privilege of publishing Queen Victoria's 'Leaves from the Journal of Our Life in the Highlands' and 'Early Years of the Prince Consort,' as well as Sir Theodore Martin's 'Life of the Prince Consort.' Perhaps the most notable achievement of Smith's life was the publication of the 'Dictionary of National Biography' (63 vols., 1885–1900) which was followed by a supplement (3 vols., 1901) to which is prefixed a memoir of the publisher's life by the editor, Sidney Lee.

SMITH, George Otis, American geologist: b. Hogdon, Me., 22 Feb. 1871. He was graduated at Colby College in 1893 and took his Ph.D. at Johns Hopkins University in 1896. He was engaged in geological work in Michigan, Utah, Washington and New England from 1893; was connected with the United States Geological Survey from 1896, became assistant geologist in 1901, and after serving as geologist in 1901–07 he became director of the survey. He was president of the Washington Geological Society in 1909, and is author of many papers and reports in connection with his work.

SMITH, George Williamson, American educator: b. Catskill, N. Y., 21 Nov. 1836 He was graduated from Hobart College in 1857, was principal of the Bladensburg Academy, Maryland, in 1858–59, and in 1861–64 was clerk of the United States Navy Department while studying theology. He was ordained to the Protestant Episcopal priesthood in 1864, was chaplain in the United States navy in that year and in 1864–65 was acting professor of mathematics at the United States Naval Academy at Newport. He was chaplain at the Naval Academy at Annapolis in 1865–68, on the United States steamship *Franklin* in 1868–71, rector of Grace Church, Jamaica, Long Island, N. Y., in 1872–81, and of the Church of the Redeemer, Brooklyn, N. Y., in 1881–83; president of Trinity College, Hartford, Conn., 1883–1904; emeritus professor of metaphysics since 1904; and from 1905 associate minister Saint John's Church, Washington.

SMITH, Gerrit, American philanthropist, reformer and statesman: b. Utica, N. Y., 6 March 1797; d. New York, 28 Dec. 1874. He was graduated from Hamilton College in 1818, subsequently devoted himself to the management of his great landed estate in central and northern New York, and was very successful in matters of his business. His credit is indicated by a well-known anecdote of the financial panic of 1837. In need of ready money, he obtained from John Jacob Astor a loan of $250,000, agreeing to execute mortgages on certain tracts of land as security. The mortgages were duly executed, but were not forwarded by the county clerk. Astor had loaned a quarter of a million on the basis of a verbal arrangement only, and for weeks remained satisfied. To many, Smith was known simply for his wealth and his use of it. During his life he gave away more than $8,000,000. His name was at the head of almost every subscription list of the time. A large portion of his beneficences fell to various established institutions, but much also to private charities in checks large and small. In 1846 he made a gift of 3,000 deeds, each for from 40 to 60 acres of land, to black and white poor. His efforts thus to further negro colonization in the North were unfortunately not successful, owing in part to the fact that the lands were unsuited to agriculture, but more to the fact that the negroes were as yet unfitted for independent farming. In 1825 Smith became a member of, and generous contributor to, the American Colonization Society, but withdrew from it in 1835 upon becoming convinced that it had nothing at all to do with the promotion of the anti-slavery cause in the United States, and joined the Anti-Slavery Society, of which he was thereafter a leading member. His object was the development of a public opinion that would demand abolition. By extensive correspondence, by frequent speeches, and by large gifts of money he furthered the movement of which he was, indeed, a most zealous exponent, but perhaps somewhat more genial than many. He assisted in the operation of the «underground railway»; and he furnished money to John Brown, though not implicated, as was alleged, in the Harper's Ferry attack. In politics Smith of course followed his reformatory views, and had no interest in party maneuvering. By politicians generally he was naturally considered an «intractable visionary.» He was defeated for the State senate in 1831. Under his leadership the Liberty party was formed at Arcade, Wyoming County, N. Y., 29 Jan. 1840; his idea was that neither of the two great parties was fitted to deal with slavery, but his purpose was general political reform and not simply abolition, as was popularly understood. The party never had great strength, its constituency being neither well organized nor well directed for party ends. By 1860 it was virtually dead. Smith was its candidate for the Presidency in 1848 and 1851. The «Industrial Congress» at Philadelphia nominated him for the Presidency in 1848, the Land Reformers in 1856; both nominations were declined. He was an unsuccessful candidate for governor of New York in 1858 on the Anti-Slavery ticket. In 1853 he was elected to Congress by a plurality as an «Independent.» He served one session and then resigned, after having made several clear and decided speeches, one a powerful attack on the «Nebraska bill» 6 April 1854. During the Civil War he vigorously supported the government, but after it, holding that the North was not blameless in the matter of slavery, counseled moderation toward the South, and in accordance with this view went on the bail-bond of Jefferson Davis with Horace Greeley, and interceded in behalf of «Ku-Klux» prisoners at Albany. Subsequently he was active in various measures, among them the assistance of Mazzini, the Italian patriot. He withdrew from the Presbyterian Church, and built an edifice at Peterboro for a non-sectarian congregation, before which he sometimes preached. Smith was much persecuted, like most of those who in a prominent way disregard expediency and circumstance. Garrison, often at odds with him, wrote after his death: «His case is hardly to be paralleled among the benefactors of mankind in this or any other country.» Smith's more important writings are 'Speeches in Congress' (1856); 'Sermons and Speeches' (1861); 'The Theologies' (1866); 'Nature's Theology' (1867); 'Letter from Gerrit Smith to Albert Barnes' (1868). Consult the biography by Frothingham (1878).

SMITH, Gerritt, American composer and organist, grandnephew of the preceding: b. Hagerstown, Md., 11 Dec. 1859; d. 1912. He studied music abroad, was organist in Saint Paul's Cathedral at Buffalo, N. Y., and Saint Peter's Church at Albany, N. Y. From 1885 he was organist of the South Church, Madison avenue, New York, where he gave nearly 300 free recitals. He was professor of music at Union Theological Seminary, honorary president of the Guild of American Organists, and a well-known writer on musical topics, his compositions including over 75 songs and instrumental pieces and the cantata 'King David.'

SMITH, Goldwin, English scholar and author: b. Reading, Berkshire, 13 Aug. 1823; d. Toronto, 7 June 1910. He was graduated from Oxford (University College) in 1845, became Fellow of his college in 1847, was called in that year to the bar at Lincoln's Inn, in 1850 was made assistant secretary of the royal commission on the state of Oxford University, and in 1858–66 was regius professor of modern history at Oxford. His lectures on Cromwell claimed attention and aroused controversy. In 1862–65 he co-operated with Bright in exerting his influence in favor of the American Union, by speeches, by signed articles and by anonymous contributions on politics to the *Saturday Review*, then very powerful. From 1868 to 1871 he was professor of English and constitutional history in Cornell University, but then removed to Toronto, Canada, where he edited the *Canadian Monthly* (1872–74), and founded *The Bystander* (no longer published) and *The Week*. He was a consistent advocate of the annexation of Canada to the United States, his 'Canada and the Canadian Question' (1891) being a valuable hand-book of argument. His 'United States: An Outline of Political History 1492–1871' (1893) is an excellent work. Among his other volumes are 'Lectures on the Study of History' (1861); 'The Empire' (1863); 'Irish History and Irish Character' (1863); 'Three English Statesmen' (Pym, Cromwell, Pitt) (1867); 'Cowper' ('English Men of Letters' 1880); 'The Moral Crusader, William Lloyd Garrison' (1892); 'Bay Leaves' (renderings from Latin poets) (1893); and 'Essays on Questions of the Day' (1894; rev. ed. 1904); 'My Memory of Gladstone' (1903). In his many contributions to periodicals he was known for his philosophical interpretation of current political and social phenomena. His writings show great impartiality and literary skill. Consult 'Reminiscences' ed. by Haultain, T. A. (New York 1910); also Haultain, T. A., 'Goldwin Smith: His Life and Opinions' (London 1913).

SMITH, Green Clay, American congressman and Baptist clergyman: b. Richmond, Ky., 2 July 1832; d. Washington, D. C., 29 June 1895. He was graduated from Transylvania University in 1850, and admitted to the bar in 1853. In 1860 he was elected to the Kentucky legislature, but resigned this office to take active part in the Civil War. He was promoted colonel in the Union army in 1862, and brigadier-general of United States volunteers in the following year. Resigning his commission he sat in the 38th and 39th congresses and in 1866 became governor of the Territory of Montana. He retired from political life to study for the ministry in 1869, was pastor of a Baptist church in Frankfort, Ky., and in 1876 the candidate of the Prohibition Party for President of the United States. He was at the time of his death pastor of the Metropolitan Baptist Church of Washington, D. C.

SMITH, Gustavus Woolson, American army officer: b. Scott County, Ky., 1 Jan. 1822; d. New York, 23 June 1896. He was graduated from the United States Military Academy in 1842 and assigned to duty at Fort Trumbull, in whose construction he assisted. He was assistant professor of engineering at West Point from 1844 to 1846, but was transferred to active service in the war with Mexico. He was brevetted captain 20 Aug. 1847, and was engaged in the siege of the City of Mexico in the following month. In 1861 he entered the Confederate army and at the expiration of the war retired to private life. He published 'Confederate War Papers' (1883); and 'Battle of Seven Pines' (1891).

SMITH, Hannah Whitall, American Quaker and philanthropist: b. Philadelphia, 1832; d. 1 May 1911. She was educated at the Quaker school of Miss Longstroth and in 1851 was married to Robert Pearsall Smith, also a Quaker. She conducted Bible classes for women at her home in Philadelphia, which she made a headquarters for various religious projects. In 1873–74, with her husband, she conducted a series of religious meetings in England. In 1888 she removed with her family to England and lived in London the remainder of her life. She was well known as a speaker on religious and other subjects, and was an ardent worker for temperance and woman suffrage. Author of 'The Unselfishness of God' (1903); 'The Christian's Secret of a Happy Life' (1908), etc.

SMITH, Harry Bache, American playwright: b. Buffalo, N. Y., 1860. Before writing for the stage he spent some years as literary and dramatic critic for the newspapers of Chicago. He is the librettist of a number of well-known light operas, the most popular among which are 'Robin Hood'; 'The Little Corporal'; 'The Tar and the Tartar'; 'Foxy Quiller'; 'Boccaccio'; 'The Viceroy,' etc.

SMITH, Sir Henry Babington, British financial expert: b. Jordan Hill, Renfrewshire, Scotland, 29 Jan. 1863. He was educated at Trinity College, Cambridge. He was private secretary to the Earl of Elgin, Viceroy of India, in 1894–99; representative of the Treasury at Natal in 1899; government representative on various missions connected with the postal and telegraph services; secretary to the Post Office in 1903–09; and in 1909 became president of the National Bank in Turkey. He was a member of the financial mission to the United States in the interests of the Anglo-French loan in 1915; and later in 1915 he was appointed chairman of the Royal Commission on Civil Service.

SMITH, Henry Boynton, American theologian: b. Portland, Me., 21 Nov. 1815; d. New York, 7 Feb. 1876. He was graduated from Bowdoin in 1834, studied theology at Andover and at Bangor, and subsequently in Halle and Berlin. He became pastor of the Congregational church at West Amesbury, Mass., in 1842, but in 1847 accepted the chair of mental and moral philosophy at Amherst. He was professor of church history in Union Theological Seminary, New York, in 1850–55, and occupied the chair of systematic theology there 1855–73, after which he became professor emeritus. He founded the *American Theological Review* in 1859 and edited it until 1862 when it was merged in the *Presbyterian Review,* of which he was editor until 1871. He was the author of ‘The Relations of Faith and Philosophy’ (1849); ‘An Argument for Christian Churches’ (1857); ‘History of the Church of Christ in Chronological Tables’ (1859); and edited and partially translated Gieseler's ‘Church History’ (5 vols., 1859–63); translated Hagenbach's ‘History of Christian Doctrine’ (1861–62), etc. Consult ‘Memoirs,’ edited by his wife (1881); and the biography by Stearns (1892).

SMITH, Henry Hollingsworth, American surgeon: b. Philadelphia, Pa., 10 Dec. 1815; d. there, 11 April 1890. He was graduated at the University of Pennsylvannia in 1837, and afterward studied in Europe. He was engaged in practice at Philadelphia, after 1841, was surgeon in several hospitals there, and in 1855–71 he was professor of surgery at the University of Pennsylvania, after which time he was professor emeritus there. He was appointed surgeon-general of Pennsylvania upon the outbreak of the Civil War, and organized the hospital department of the State. He originated the plan of removing the wounded from the battlefields to the hospitals of Philadelphia, Harrisburg, Reading and other cities, and put into practice the embalming of the dead on the battlefields. After thoroughly organizing the military hospital service of the State he retired in 1862. Author of ‘System of Operative Surgery’ (2 vols., 1852); ‘Practice of Surgery’ (2 vols., 1857–63), etc.

SMITH, Henry John Stephen, Irish mathematician: b. Dublin, 2 Nov. 1826; d. 3 Feb. 1883. He was graduated from Balliol, Oxford, in 1850, and the same year began to lecture on mathematics there and continued in this lectureship until 1873. In 1860 he was also appointed to the Savilian chair of geometry at Balliol. His development of the theory of numbers placed him among the greatest mathematicians of his day. He is also known for his demonstrations of a great number of advanced theorems in higher mathematics. His mathematical papers were collected in 1894 in two volumes, to which was prefixed a biographical sketch by Charles H. Pearson (q.v.).

SMITH, Henry Preserved, American educator: b. Troy, Ohio, 23 Oct. 1847. He was graduated from Amherst in 1869, studied at Lane Theological Seminary, Cincinnati, Ohio, in Berlin and in Leipzig, and in 1864 was ordained in the Presbyterian Church. He occupied a chair at the Lane Theological Seminary in 1877–73, which he resigned because of the charge of heresy brought against him by the Cincinnati Presbytery. He was convicted of the charge by both the Presbytery and the General Synod and thereupon retired from the Presbyterian Church. In 1898 he became professor of biblical literature in Amherst College was received into the Congregational ministry. From 1907 to 1913 he was professor of Old Testament literature and the history of religions in the Meadville (Pa.) Theological School. Since 1913 he has been librarian of Union Theological Seminary, New York City. He has published ‘Inspiration and Inerrancy’ (1893); ‘The Bible and Islam’ (1897); ‘Commentary on the Books of Samuel’ (1899); ‘Old Testament History’ (1903); ‘The Religion of Israel’ (1914).

SMITH, Hoke, American statesman: b. Newton, N. C., 2 Sept. 1855. He was educated in a preparatory school conducted by his father, Hosea H. Smith, LL.D., at Chapel Hill, and admitted to the bar in 1873. In 1887 he purchased the Atlantic *Journal,* and was a strong supporter of President Cleveland. In Cleveland's second term he served as Secretary of Interior from 1893–96. In the latter year he was elected governor of Georgia, running on a reform ticket. He was defeated for re-election in 1910, but again elected in 1911. Shortly thereafter he was called to the United States Senate and re-elected in 1915 to serve six years. He has been very active in legislation, and is regarded as one of the strong men of the Democratic party.

SMITH, Horatio (always called Horace), and **James,** English authors: b. London, 31 Dec. 1779 and London, 10 Feb. 1775; d. Tunbridge Wells, 12 July 1849, and London, 24 Dec. 1839. James Smith became solicitor to the board of ordnance, and Horace a stock-broker. Being both of a literary turn, the brothers became contributors to the *Pic Nic* newspaper, founded in 1802, and from 1807 to 1810 contributed numerous papers to the *Monthly Mirror,* among these the ‘Imitations of Horace,’ which were afterward published separately. In 1812 the competition offered by the mangement for the best address to be read at the opening of Drury Lane Theatre, when rebuilt after the fire, suggested to the Smiths the idea of producing a collection of parodies of the most noted writers of the day, under the title ‘Rejected Addresses.’ The work on being issued was hailed with the most enthusiastic applause, and rapidly ran through numerous editions. Its popularity still continues great, and deservedly, for few *jeux d'esprit* are more happy than the burlesques of the poetry of Wordsworth, Crabbe and Sir Walter Scott (undoubtedly the best; Scott said of it, «I certainly must have written this myself, although I forget upon what occasion»), the pompous prose of Johnson, or the bluntness of Cobbett. Jeffreys said he took the 'Addresses' to be the "very best imitations, and often of difficult originals, that ever were made." Calverley alone has equaled them. James, satisfied, did no more literary work save a few comic songs and some *vers de société;* but Horace set himself to the writing of novels, and produced among others 'Brambletye House' (1826); 'Reuben Apsley' (1827); 'The Moneyed Man' (1841); 'Adam Brown' (1843).

SMITH, Isaac Townsend, American banker: b. Boston, 12 March 1813; d. New York city, 30 March 1906. He entered commercial life as supercargo, making several East India voyages in 1834–38. He afterward settled in New York as merchant and ship owner; then became one of the incorporators and for many years president of the Metropolitan Savings Bank. He was during 1878–84 commissioner of immigration for the State of New York; and acted as presidential elector at the re-election of Abraham Lincoln in 1864. At the opening of commercial relations between Siam and the United States in 1845 he became financial agent for Siam, and served in that capacity or as consul and consul-general at New York till his death.

SMITH, Jacob Hurd, American soldier: b. Jackson, Ohio, 29 Jan. 1840. He was graduated at the Collegiate and Commercial Institute, New Haven, Conn., in 1858. He enlisted in the Union army in May 1861 and attained the rank of captain. He afterward served in Indian frontier warfare and in the war with Spain. He was promoted colonel in 1899, brigadier-general of volunteers in 1900, and received that rank in the regular army on 1901. He held an excellent record in the service, but while in command of the sixth separate brigade in Samar, Philippine Islands, he was alleged to have issued orders of unwarranted severity in the warfare against the Philippine insurgents. He was court-martialed 21 April 1902, and was retired from active service 17 July 1902 with a reprimand from President Roosevelt.

SMITH, James, American legislator and signer of the Declaration of Independence: b. Ireland, about 1720; d. York, Pa., 11 July 1806. He came to America with his father in 1829, and was educated at the College of Philadelphia. He engaged in law practice and surveying at Shippensburg, and later became the only practitioner of law at York, Pa. He took a prominent part in the early revolutionary movement in Pennsylvania, raised the first volunteer company in the State for the purpose of resisting British authority, and considerably accelerated the patriot movement through his essay 'On the Constitutional Power of Great Britain over the Colonies in America.' He was a delegate to the Pennsylvania Convention in January 1775, to the Provincial Conference in June 1775; and as a member of the Continental Congress, in which he served in 1775–78, he signed the Declaration of Independence. He was a member of the Pennsylvania State Constitutional Convention in 1776, served in the State assembly in 1779, was judge of the High Court of Appeals in 1780, and was appointed brigadier-general of the Pennsylvania volunteers in 1782. He was a friend and staunch supporter of Washington, and sacrificed his personal fortune in the Revolutionary cause.

SMITH, James, American pioneer: b. Franklin County, Pa., 1737; d. Washington County, Ky., 1812. He was captured by Indians at the age of 18, was adopted into one of their tribes and was held by them for four years before he escaped. He was leader of the "Black Boys," a company formed for Indian warfare in 1863; and was a lieutenant under Gen. Henry Bouquet in the expedition against the Ohio Indians in 1764. He was one of the pioneer settlers of Westmoreland County, Ky., in 1768, first accompanying a band of explorers into that territory in 1766. He was a member of the Pennsylvania Convention in 1776, and served in the Pennsylvania assembly in 1776–77. He commanded a scouting party against the Indians in the Jerseys in 1777, and later in that year was commissioned colonel in command of the warfare on the frontiers. After 1788 he lived near Paris, Ky., and served for many years in the State legislature. He was author of 'Remarkable Adventures in the Life and Travels of Col. James Smith' (1799; new ed. 1870); 'A Treatise on the Mode and Manner of Indian Warfare' (1804).

SMITH, James Argyle, American military officer: b. 1 July 1831; d. Jackson, Miss., 6 Dec. 1901. He was graduated from the United States Military Academy in 1853, but at the outbreak of the Civil War joined the Confederate army, and was promoted brigadier-general in 1863. From 1878 to 1882 he was superintendent of education of the State of Mississippi. Eleven years later he was restored to the United States army, and during the next four years was on duty at various army posts in the West.

SMITH, James Francis, American soldier and judge: b. San Francisco, 28 Jan. 1859. His education was gained at Santa Clara College and Hastings Law School. He was admitted to the bar in 1881. He enlisted at the outbreak of the Spanish War and was made colonel of the First California regiment, United States volunteers, joining the first expedition to the Philippine Islands. He participated in the taking of Manila, 13 Aug. 1898, and was made president of the military commission there the following year; he was also a member of the commission that conducted a conference with Aguinaldo. He fought later at Santa Ana, San Pedro Mecati, Pateros and Lagnig, and was commended for gallantry. In April 1899, he was advanced to brigadier-general, and held commands of the department of Visayas, was military governor of the Island of Negros, and (1900) collector of customs for the Philippine Archipelago. Being honorably discharged from the service in 1901 he was appointed justice of the Supreme Court of the Philippine Islands, 17 June 1901. Later he was made governor-general of the islands, but resigned in 1909, and returned to the United States. In 1910 he was made associate justice of the United States Court of Customs Appeals in San Francisco.

SMITH, Jessie Wilcox, American artist: b. Philadelphia, Pa., 19th century. She studied at the Philadelphia Academy of Fine Arts and under Howard Pyle at the Drexel Institute. She has been engaged in book and magazine illustrating since 1890 and is well known for her clever and sympathetic delineation of child life. Her work has appeared in *Harper's Magazine*, *Scribner's Magazine*, *Collier's Weekly*, the *Ladies' Home Journal* and other periodicals, as well as in books published by Houghton, Mifflin and Company and by Little, Brown and Company. Mention may be made of the series ‹The Child's World›; ‹The Five Senses›; ‹Seven Ages of Childhood›; and her illustrations for the ‹Mother Goose Rhymes.›

SMITH, John, English soldier and colonist, founder of Virginia: b. Willoughby, Lincolnshire, 1580; d. London, June 1631. In 1596 he enlisted in the French army to fight against Spain, but after the peace in 1598 transferred his services to the insurgents in the Netherlands, and there remained until about 1600. After study of the theory of warfare and practice in the cavalry exercises of the time, he started on a career of marvelous adventure, performing very many exploits, for which his own narratives are the only authority. Having shipped, he says, from France for Italy, he was thrown overboard as a Protestant, but ultimately was rescued by a pirate, and after receiving a share of booty from a Venetian prize, went through Italy and Dalmatia to Styria, and enlisted in the forces of the Archduke of Austria against the Turks. He places emphasis upon his ingenuity in the device of a system of signaling by means of which the imperial army was enabled to communicate with the invested garrison of Limbach and thus raised the siege. After having killed three Turkish champions in a series of duels before the assembled armies, he was at last taken prisoner at Rotenturm, and sold as a slave. But he escaped, and finally got to Morocco, whence he returned in an English warship to England in 1605. Fuller (‹Worthies of England›) thought of these «strange performances» that their scene was «laid at such a distance they are cheaper credited than confuted.» Later investigators allow them some basis of truth. When Smith got back he busied himself in the schemes of colonization in the New World which were being undertaken in consequence of the recent discoveries. An enterprise with which he was identified for a settlement in Guiana fell through, and he then sailed from Blackwall, 19 Dec. 1606 among the 105 emigrants who, under royal patent, were to establish a colony in Virginia. In the passenger-list he is styled a planter. The expedition of three vessels went by way of the West Indies, reached the coast of Virginia on 26 April, and then opened the sealed instructions containing the list of members of the council. Among them was Smith, who was not at first permitted to act because during the voyage for some reason unknown he had been placed under arrest by Captain Newport, commander of the fleet. On 13 May 1607 the colonists landed about 50 miles from the mouth of the river they called the James, at a peninsula on its northern bank, where they built Jamestown. The site was strongly approved by Smith, though opposed by Bartholomew Gosnold, another of the council. From the start Smith was active in the work of the colony, and on 10 June he was admitted to office. Fortifications were built, and then he made excursions into the surrounding region for food. He proved an excellent leader, and soon became virtually the director of the colony. During one of his journeys he was taken prisoner by the Indians (December 1607), but later released on promise to furnish a ransom of «two great guns and a grindstone.» In an interpolation in his ‹Generalli Historie (1624), Smith says that it was during this captivity that he was saved from death by Pocahontas (q.v.). Charles Deane (q.v.), the antiquary, in his edition (1860) of Wingfield's ‹Discourse,› was the first to point out that the story was at variance with Smith's narratives in the tracts composing the book when they were published contemporaneously with the events they recorded. But Smith has found many defenders, such as Arber in his memoir in the ‹Encyclopædia Britannica› (9th ed. 1887) and his edition (1884) of Smith's ‹Works,› and Poindexter in ‹Captain John Smith and his Critics› (1893). The matter, like Smith's general veracity, remains an object of controversy. Wingfield, the first elected president of the colony, was deposed in September 1607, Smith taking a leading hand in the business. Ratcliffe, the successor, held office a year, and 10 Sept. 1608 Smith was made formal head. He enforced discipline, strove to correct the unthrifty methods of the colonists, had them build a church, strengthen the defenses, and make some provision for agriculture and fishery. He made two voyages, covering in all, he reckoned, 3,000 miles, about the coasts of Chesapeake Bay, which he mapped with its environs. A new party of colonists arrived in August 1609. Smith refused to surrender the government of the colony, and the newcomers chose Francis West president. Smith's term having later expired, George Percy was elected and West made a councillor. About 29 September Smith left for England. He never returned to Jamestown. He left the colony in a most favorable condition. In 1614 he made a voyage of exploration to New England and prepared a map of the coast from the Penobscot to Cape Cod, the first properly to indicate the outline of it. He made two attempts in 1615, being frustrated in the first by a storm and in the second by being taken prisoner by the French. In 1617 he started again, but bad weather kept him in port, and he retired to London where he made maps and wrote pamphlets. Smith was certainly a prominent figure of his time, and whatever his tendency to embellishment and imagination as a historian, he really achieved much in Virginia. He was a good example of Elizabethan versatility, «bookman, penman, swordsman, diplomat, sailor, courtier, orator.» His service to America in the early 17th century remains the greatest part of his career. His most important works are ‹True Relation› (1608; ed. by Deane, C., Boston 1867); ‹Maps of Virginia› (1612); ‹Description of New England› (1616); ‹New England's Trials› (1620). Consult Arber, E., ‹Complete Works of Captain John Smith› (Birmingham 1884; London 1895); Ashton, J., ‹Adventures and Discoveries of Captain John Smith› (New York 1883); Bradley, A. G., ‹Captain John Smith› (New York 1905); Jenks, T., ‹Captain John Smith› (New York 1904); Smith, E. B., ‹Pocahontas and Captain John Smith› (Boston 1914); Warner, C. D., ‹Life of Captain John Smith› (New York 1881); Wertenbaker, T. J., ‹Virginia under the Stuarts› (Princeton 1914). See JAMESTOWN.

SMITH, John Bernhardt, American entomologist: b. New York, 21 Nov. 1858; d. 12 March 1912. He was admitted to the bar in 1879, but subsequently turned to the study of entomology, and in 1884 was appointed a special agent of the United States Department of Agriculture. He became assistant curator of the United States National Museum in 1886; was appointed State entomologist of New Jersey in 1888 and from 1889 he was professor of entomology at Rutgers College and entomologist at the New Jersey Agricultural Experiment Station. He became widely known in the course of his work in charge of the New Jersey campaign for the extermination of its mosquitoes, for which an appropriation of $350,000 was voted; and did noteworthy work in connection with the fight against the San José scale. Author of ‹Economic Entomology for Farmer and Fruit Grower› (1896); ‹Our Insect Friends and Enemies› (1909), etc.

SMITH, John Lawrence, American chemist and physician: b. Charleston, S. C., 17 Dec. 1818; d. Louisville, Ky., 12 Oct. 1883. He was educated at the University of Virginia and the South Carolina Medical College, studied chemistry in Europe with Liebig and Pelouze, and established in 1846 the *Medical and Surgical Journal of South Carolina.* He was appointed bullion assayer by the State of South Carolina; and in 1846 entered the service of the Turkish government to report upon the cotton culture and the mineral resources of Turkey. He returned to America in 1850 and taught chemistry in the medical department of the University of Louisville 1854–66. He made one of the largest known collections of meteorites, which after his death was acquired by Harvard University. He received decorations from the French, Turkish, and Russian governments; in 1874 was president of the American Association for the Advancement of Science; in 1877 of the American Chemical Society, and in 1879 succeeded Sir Charles Lyell as corresponding member of the Academy of Sciences of the Institute of France. The more important of his numerous published papers were issued by him as ‹Mineralogy and Chemistry, Original Researches› (1873–84).

SMITH, John Talbot, American Roman Catholic clergyman, author and lecturer: b. Saratoga, N. Y., September 1855. He was graduated from Saint Michael's College, Toronto, Canada, 1881; missionary in the Adirondacks 1881–89, editor of the *New York Catholic Review* 1889–92, president of the Catholic Summer School 1905–09, and founded the Catholic Actors' Guild of America 1914. He has published the novels, ‹A Woman of Culture› (1881); ‹Solitary Island› (1886); ‹His Honor the Mayor› (1891); ‹Saranac› (1893); ‹The Art of Disappearing› (1905); ‹The Black Cardinal› (1914); also ‹The History of the Ogdensburg Diocese› (1884); ‹The Training of a Priest› (1896); ‹Life of Brother Azarias› (1897); ‹History of the Diocese of New York› (1905); and two volumes of sermons.

SMITH, John Walter, American senator: b. Snow Hill, Md., 5 Feb. 1845. He was educated at Washington Academy. As a member of the Democratic party he was elected to the Maryland State senate in 1888, serving there till 1899; in 1894 he was president of the senate; and in 1895 chairman of the Democratic State Committee. In 1896 he was nominee for the United States Senate, and 1899–1901 was member of Congress. From 1900–04 he was governor of Maryland, and from 1909 was United States Senator.

SMITH, James Waldo, civil engineer: b. Lincoln, Mass., 9 March 1861. His education was obtained at Phillips Academy, Andover, and the Massachusetts Institute of Technology. After serving as chief engineer of the waterworks of his own town, though barely 17, he assisted in various engineering works connected with water supply, and in 1892 was placed in charge of the Passaic (N. J.) Water Company. Having had successful experience in developing the water supplies of several cities in New Jersey he was in 1903 chosen chief engineer of the aqueduct commissions of New York, and under his direction the plans were worked out for the Catskill water supply, to deliver 500,000,000 gallons of water daily in New York city at high pressure. This gigantic work cost about $170,000,000, and was successfully completed. See CATSKILL.

SMITH, Joseph, American Mormon leader: b. Sharon, Windsor County, Vt., 23 Dec. 1805; d. Carthage, Ill., 27 June 1844. In 1820 when living as a farm laborer at Manchester, Ontario (now Wayne) County, N. Y., at the time of a religious revival he prayed, according to his own account, for guidance, and was told by two heavenly messengers not to join any sect. On 21 Sept. 1823 an angel, that he called Moroni, told him of a book engraved on gold plates and containing the «fulness of the everlasting gospel.» He was instructed to dig for the plates in the hill Cumorah, four miles from Palmyra, between that town and Manchester. These plates, the characters on which were in a tongue styled «reformed Egyptian,» Smith translated by means of interpreters (Urim and Thummim) found with the plates, and with the assistance of amanuenses who received his dictation. Smith received the priesthood of Aaron from John the Baptist and of Melchizedek from Peter, James and John. On 6 April 1830 the Mormon Church was organized at Fayette, Seneca County, N. Y., and Smith was recognized as the prophet of a new dispensation. (For subsequent details of Smith's career see MORMONS). While residing at Nauvoo, Ill., the feeling against him resulting from religious and political differences, culminated in his murder by a mob, which broke into the jail at Carthage, where he had been placed for safe-keeping after surrendering for trial upon certain charges preferred against him at the instance of personal enemies, seceders from the Church that he had founded.

SMITH, Joseph (son of Joseph Smith who was instrumental in organizing the Church of Jesus Christ of Latter Day Saints, at Fayette, New York, 6 April 1830): b. Kirtland, Ohio, 6 Nov. 1832; d. Independence, Mo., 10 Dec. 1914. He resided with his parents at Kirtland, Ohio, until their removal to Far West, Missouri, in 1838. Within a year afterward when his father was arrested by a drunken militia, this boy was thrust from his father at the point of the bayonet and rudely told that he would see his father no more.

In the winter of 1838–39 he accompanied his mother into Illinois, banished from the State under the edict of Governor Lilburn W. Boggs of Missouri. He and his adopted sister crossed the ice of the Mississippi River at Quincy, Ill., clinging to his mother's skirts while she carried his two younger brothers in her arms. After his father joined the family near Quincy, Ill., they settled at Commerce, subsequently called Nauvoo, Ill. Here he witnessed the years of prosperity of the family, also the severe persecution which resulted in the death of his father at the hands of a mob at Carthage, Ill., 27 June 1844.

At Nauvoo he was reared to manhood and spent his early years honored and respected and was several times trusted by his fellow citizens in the office of justice of peace. On the 6 April 1860 at a conference of the Reorganized Church of Jesus Christ of Latter Day Saints held at Amboy, Ill., he was chosen as president of that Church. His presidency of over half a century was exercised with patience and the respect of his people and no breath of suspicion against his moral integrity was ever heard. President Smith was three times married; first in 1856 to Miss Emmaline Griswold who died in 1869, subsequently to Miss Bertha Madison who died in 1896, and then to Miss Ada Clarke who survived him but who has since died. The fruit of these three unions was 17 children, 10 of whom are still living, six sons and four daughters. He died at Independence, Mo., 10 Dec. 1914, honored and respected as a consistent leader and near companion by church associates; and by fellow citizens as a loyal, upright and valuable citizen of town, county and State. See REORGANIZED CHURCH OF JESUS OF LATTER DAY SAINTS.

SMITH, Joseph Fielding, American religious leader, president of the Church of Jesus Christ of Latter Day Saints, nephew of Joseph Smith (1805–44): b. Far West, Caldwell County, Mo., 13 Nov. 1838; d. Salt Lake City, Utah, 19 Nov. 1918. His childhood was spent amid persecutions and hardships which finally resulted in the martyrdom of his uncle and his father at Carthage, Ill., 27 June 1844. In 1846 his mother with her family left her home in Nauvoo, Ill., as an exile, with the majority of the Latter Day Saints, who were driven from their homes. In this exodus, Joseph drove an ox-team to Winter Quarters, on the Missouri river, where the family remained until the spring of 1848, when they continued their journey to the west. From Winter Quarters to Salt Lake Valley, Joseph drove two yoke of oxen attached to a heavy-laden wagon, a distance of more than 1,000 miles, and arrived in the valley 23 Sept. 1848. He was engaged in manual labors 1848–54, and in the last-named year went as a missionary to the Hawaiian Islands, where he remained until 1857, gaining a thorough knowledge of the native tongue. He returned to Utah in 1858 and on 21 March 1858 was ordained to the office of a Seventy, and on 16 October of the same year to the office of a High Priest and member of the High Council of the Salt Lake State. He labored as a missionary in Great Britain 1860–63 and in 1864 returned to the Hawaiian Islands on his second mission, where he resided until his return to Utah in 1865. While on his third mission to the Hawaiian Islands, 1885–87, he became acquainted with Prof. L. L. Rice, the possessor of the original manuscript of the much famed "Spaulding Story" which many over-zealous anti-"Mormons" have tried in every possible way to connect with the Book of Mormon, and from him he obtained an exact copy of the manuscript, which being published in book form, effectually disproved the Spaulding theory, according to Pres. James H. Fairchild, of Oberlin College, who compared the two productions. On 1 July 1866 he was ordained an apostle and was received into the quorum of the Twelve Apostles 6 Oct. 1867. In February 1874 he started on his second mission to Europe, this time to preside over the European mission and to edit the *Millennial Star,* the Church periodical in England. He remained there until the fall of 1875, when he returned to Utah and was appointed to preside over the Latter Day Saints in Davis County. This position he held until the spring of 1877 when he was again appointed to preside over the European mission, and for the third time left for Great Britain. He traveled in this field, visiting the different branches in England and on the Continent, until the death of President Brigham Young, 29 Sept. 1877, when he was called home. He was second counsellor to the presidency 1880–1901, and first counsellor April 1901 to 10 Oct. 1901. On the last-named date he was sustained as president of the Church.

President Smith's civic record comprises the offices of territorial legislator, city councillor, and university regent, in all of which he served repeatedly. As a member of the municipal government he was the main mover in securing from heirs of President Brigham Young Liberty Park and Pioneer Square as public parks for Salt Lake City. He was a member of the House of the Utah legislature 1865, and in 1882 was a member of the legislative council, presiding over it at the latter session. He was also president of the constitutional convention held the same year. He assisted in the organization of Zion's Co-operative Mercantile Institution, Zion's Savings Bank and Trust Company, the State Bank of Utah, and the Utah Sugar Company, over all of which he was the president. He was also president of the Consolidated Wagon and Machine Company and was connected with many other concerns.

In the auxiliary organizations of the Church he was the head of the Young Men's Mutual Improvement Association and the Deseret Sunday School Union, and was senior editor of the *Improvement Era* and the *Juvenile Instructor,* the official organs of these two organizations of young people of the church.

Early in 1904 President Smith was summoned to Washington to testify before the Senate Committee of Privileges and Elections in the case of Reed Smoot (q.v.), senator-elect from Utah, upon whose eligibility the committee was called to pass. During a prolonged examination the witness displayed a mental resourcefulness equal to that of his distinguished interrogators.

SMITH, Joshua Toulmin (TOULMIN SMITH), English author: b. Birmingham, 29 May 1816; d. Lancing, Sussex, 28 April 1869.

JOSEPH F. SMITH

Late President of the Church of Latter-Day Saints

He entered Lincoln's Inn in 1835 to study for the bar, but soon turned his attention to literature, especially interesting himself in the Scandinavian languages and literature. He lived in the United States, at Detroit, Utica and Boston, in 1837–42, engaged in lecturing and writing. During this period he published his 'Discovery of America by the Northmen of the 10th Century' (1839), the first presentation in English of the Icelandic sagas, and a work which remains an authority. Returning to England he resumed his legal studies, made a special study of old Saxon law, and was called to the bar in 1849. He became known as a writer not only on legal topics, but on geology, in which field his 'Ventriculidæ of the Chalk' (1848) is still authoritative, and on sanitary science and mineralogy, as well as being an antiquarian of note. As a powerful and well-informed writer he exerted a wide influence. He edited *Parliamentary Remembrance* in 1857–65, a weekly report of the proceedings of Parliament amplified by historical commentaries and illustrations of unique value, but which failing health compelled him to discontinue. His 'English Gilds' (1870) was edited by his daughter and published posthumously.

SMITH, Judson, American Congregational clergyman and educator: b. Middlefield, Mass., 28 June 1837; d. Roxbury, Mass., 29 June 1906. He was graduated at Amherst College in 1859, at Oberlin Theological Seminary in 1863 and was ordained in the Congregational Church in 1866. He was professor of Latin at Oberlin in 1866–70; of ecclesiastical history and positive institutions at the Oberlin Theological Seminary in 1870–84; and was also lecturer on modern history at Oberlin in 1875–84, and lecturer on history at Lake Erie Female Seminary in 1879–84. He edited the *Bibliotheca Sacra* in 1882–84, and was thereafter associate editor. From 1884 he was foreign secretary of the American Board of Commissioners for Foreign Missions, and he made a visit of inspection to missions in Turkey in 1888 and to those in China in 1898. Author of 'Lectures in Church History' (1881); 'Lectures on Modern History' (1881).

SMITH, Julia Holmes, American physician: b. Savannah, Ga., 23 Dec. 1839. She began the study of medicine in 1873 at the medical school of the Boston University and graduated from the Chicago Homœopathic College in 1877. Since then she has practised in Chicago and contributed to medical literature. Upon appointment by Governor Altgeld she became the first woman trustee of the University of Illinois. She has been professor of gynecology and dean of the National Medical College; superintendent of the Department of the Northwest, New Orleans Cotton Exposition, 1885, and vice-president Homœopathic Congress, Columbian Exposition, 1892–93. She organized and was first president of the Woman's Medical Association. She retired from medical practice in 1914.

SMITH, Justin Harvey, American writer: b. Boscawen, N. H., 13 Jan. 1857. He was graduated from Dartmouth College in 1877, and became a member of the publishing firm of Ginn and Company. In 1899 he was called to the chair of modern history at Dartmouth, which he resigned in 1908. Has traveled extensively in North America, Europe, the Near and Far East, northern Africa, etc. He is author of 'The Troubadours at Home' (2 vols., 1899); 'Arnold's March from Cambridge to Quebec' (1903); 'A Tale of Two Worlds and Five Centuries' (1903); 'Our Struggle for the 14th Colony' (2 vols., 1907); 'The Annexation of Texas' (1911), etc., and numerous magazine articles.

SMITH, Marcus Aurelius, American lawyer and senator: b. near Cynthiana, Ky., 24 Jan. 1852. He was graduated at Transylvania University, was admitted to the bar, and in 1881 removed to Arizona where he engaged in the practice of law. He served for 16 years as territorial delegate from Arizona before her admission as a State, and upon her admission he was elected one of her first senators in 1912. He was re-elected in 1914. His work in Congress has been connected with irrigation and reclamation problems.

SMITH, Melancton, American naval officer: b. New York, 24 May 1810; d. Green Bay, Wis., 19 July 1893. He entered the navy as midshipman, was commissioned lieutenant in 1837, served in the Florida war on the *Poinsett,* and during the Civil War joined Farragut's fleet with the *Massachusetts,* destroyed the Confederate ram *Manassas,* and took part in running the batteries at Vicksburg, 14 March 1862. He was promoted commodore in 1866 and rear-admiral in 1870, and was commandant at the Brooklyn navy yard 1870–72.

SMITH, Morgan Lewis, American soldier: b. Oswego, N. Y., 8 March 1822; d. Jersey City, N. J., 29 Dec. 1874. He removed to New Albany, Ind., in 1843, served for a time in the United States army, and later engaged in the steamboat business. Upon the outbreak of the Civil War he re-entered the army, raised the Eighth Missouri infantry, and was commissioned its colonel in July 1861. He was in command of a brigade at both Fort Donelson and Shiloh, and in July 1862 he was appointed brigadier-general of volunteers. He later served under Sherman, was severely wounded at Vicksburg in December 1862, but returned to duty in October 1863 and afterward participated in the Atlanta campaign. He was later military commander of Vicksburg, where his firm measures were successful in restoring quiet and order. He resigned from the army in July 1865, and later was United States consul at Honolulu.

SMITH, Munroe, American jurist and political scientist: b. Brooklyn, N. Y., 8 Dec. 1854. He was graduated from Amherst in 1874, and from the Columbia Law School in 1877; he then studied abroad, receiving the degree of J.U.D. (doctor of laws) from the University of Göttingen. On his return from Germany in 1880 he was appointed instructor in the department of history at Columbia University, in 1883 became adjunct professor of history, and in 1891 professor of Roman law and comparative jurisprudence. He was one of the founders of the 'Political Science Quarterly' in 1886, of which he was managing editor until 1913. He has edited 'Selections from Cicero' in 'The World's Best Books' (1900), and has written 'Bismarck and German Unity' (1898; 2d ed., 1911); 'Jurisprudence' (1908); 'Military

Strategy versus Diplomacy in Bismarck's Time and Afterward' (1915), and numerous legal and political articles.

SMITH, Nathan, American physician: b. Rehoboth, Mass., 13 Sept. 1762; d. New Haven, Conn., 26 July 1828. He served in the Vermont militia the last year and a half of the Revolutionary War, and later settled in Vermont. He took up the study of medicine at the age of 24, and after some years of practice at Cornish, N. H., he entered Harvard University, where he was awarded the degree of M.B. in 1790, the third graduate of the medical department. He established the medical department at Dartmouth College in 1798, and subsequently taught most of its departments. He studied at the University of Edinburgh in 1803, afterward returning to Dartmouth. From 1813 until his death he was professor of the theory and practice of surgery at Yale University. He also lectured at the University of Vermont in 1822–25, and at Bowdoin College in 1820–25. He greatly aided the betterment of facilities for securing medical education in the United States. His practice extended over four States. He is said to have performed the first operation in America for the extirpation of ovarian tumor, and that of staphylorrhaphy; and his name is connected with an improved method of amputation of the thigh. Author of 'Practical Essays on Typhus' (1824).

SMITH, Nathan Ryno, American surgeon, son of Nathan Smith (q.v.): b. Concord, N. H., 21 May 1797; d. Baltimore, Md., 3 July 1877. He took his M.D. at Yale University in 1820 and in 1824 began the practice of surgery at Burlington, Vt. He was professor of surgery and anatomy at the University of Vermont in 1825–27; occupied the chair of surgery at the University of Maryland in 1827–28; was professor of the practice of medicine at the University of Transylvania in 1828–40; and in 1840–70 was again professor of surgery at the University of Maryland. He invented an instrument rendering the operation of lithotomy safe, and a splint for fractures of the thigh. He contributed numerous articles to the *American Journal of Medicine* and was author of 'Surgical Anatomy of the Arteries' (1832–35); 'Treatment of Fractures of the Lower Extremities by the Use of the Anterior Suspensory Apparatus' (1867), etc.

SMITH, Percey Franklyn, American mathematician: b. Nyack, N. Y., 21 Aug. 1867. He was graduated at Yale University in 1888, took his Ph.D. there in 1891 and later studied at the universities of Göttingen, Berlin and Paris. He was connected with the Sheffield Scientific School at Yale from 1888 and since 1900 he has been professor of mathematics there. He is editor of the *Transactions* of the American Mathematical Society, and was joint editor of 'Elements of Differential Calculus' (1904). Author of 'Elementary Calculus' (1902); 'Four-Place Logarithmic Tables' (1902); and joint author of 'Elements of Analytic Geometry' (1905); 'Theoretical Mechanics' (1910); 'The New Analytic Geometry' (1912), etc.

SMITH, Richard Penn, American dramatist: b. Philadelphia, 13 March 1799; d. Falls of Schuylkill, Pa., 12 Aug. 1854. He was the author of numerous plays, 15 of which were produced on the Philadelphia stage. Among them are 'Caius Marius,' a tragedy acted by Edwin Forrest in 1831; 'The Disowned' and 'The Deformed,' both presented in London; 'The Water Watch'; 'The Venetians,' and 'The Actress of Padua.' A selection of his 'Miscellaneous Works,' collected by his son, Horace Wemyss Smith, and including a biographical sketch, was published in 1856; and 'Complete Works' with sketch and memoir was published by his son in 1888 (4 vols.). Consult Rees, 'Dramatic Authors of Philadelphia.'

SMITH, Richard Somers, American educator: b. Philadelphia, Pa., 30 Oct. 1813; d. Annapolis, Md., 23 Jan. 1877. He was graduated from West Point in 1834, served on topographical duty and resigned in 1836. He was reappointed to the army in 1840, and became instructor at West Point, which position he held until 1855, when he again resigned, serving successively as professor of mathematics in the Brooklyn Institute of Technology and as a director of Cooper Institute, New York. In 1861 he was appointed to the Federal army for a third time; he served, as major of infantry, until after the battle of Chancellorsville, when he resigned his commission and accepted the presidency of Girard College, Philadelphia. He relinquished this in 1867; in 1870 was appointed professor of mathematics at the United States Naval Academy, and in 1873 was transferred to the department of drawing. His publications comprise a 'Manual of Topographical Drawing' (1853), and 'Linear Perspective' (1857).

SMITH, Roswell, American publisher: b. Lebanon, Conn., 30 March 1829; d New York, 19 April 1892. He purchased *Scribner's Monthly,* the name of which he changed to the *Century* in 1881. Securing Dr. J. G. Holland as editor he made a wonderful success, and for many years set the pace for other magazines both in America and abroad. He founded the Century Company, of which he was president until his death in 1892. Under his guidance the company also published *Saint Nicholas,* a young folks magazine, the 'Century Dictionary' and other works.

SMITH, Samuel, American soldier: b. Lancaster, Pa., 27 July 1752; d. Baltimore, Md., 22 April 1839. He was appointed captain in a Maryland regiment at the outbreak of the American Revolution and served until 1779, having been in command of Fort Mifflin when it was bombarded by the British fleet for 42 days in 1777. He resigned his commission in 1779, represented Maryland in Congress, 1793–1803 and 1816–22, and in the United States Senate, 1803–15 and 1822–33, serving much of the time as chairman of the Finance Committee. As major-general of the State militia he defended Baltimore from mob rule in 1835, and for three years afterward was mayor of that city.

SMITH, Samuel Francis, American Baptist clergyman and poet: b. Boston, Mass., 21 Oct. 1808; d. there, 16 Nov. 1895. He was graduated from Harvard in 1829, from Andover Theological Seminary in 1832 and was ordained in 1834. He was engaged in various pastorates in 1834–54, at the same time acting as professor of modern languages at Waterville College (Colby University) in 1834–42, and as editor of the Boston *Christian Review* in 1842–48. He was editor of the publications of the Baptist Missionary Union in 1854–69, and in 1875–76, 1880–82, he visited the chief missionary stations in Europe and Asia. He was famous as the author of ‘My Country 'Tis of Thee’ (1832), which became a national hymn, and he also wrote the hymn ‘The Morning Light is Breaking’ at about the same time. His publications include ‘Lyric Gems’ (1843); ‘The Psalmist’ (1843); ‘Life of Rev. Joseph Grafton’ (1848); ‘History of Newton, Mass.’ (1880); ‘Rambles in Mission Fields’ (1884), etc.

SMITH, Samuel Stanhope, American Presbyterian clergyman and college president: b. Pequa, Pa., 16 March 1750; d. Princeton, N. J., 21 Aug. 1819. He was graduated at Princeton University in 1769 and in 1774 was ordained in the Presbyterian ministry. He was the first president of Hampden Sidney College, in 1775–79. He became professor of moral philosophy at Princeton in 1779, and also held the chair of theology from 1783; he was vice-president from 1786, and was president of the university in 1795–1812. He rendered the university invaluable service in its reorganization after the ravages of the Revolution. He was one of the committee which drafted the laws of government for the Presbyterian Church. Author of ‘Lectures on Moral and Political Philosophy’ (2 vols., 1812); ‘Comprehensive View of Natural and Revealed Religion’ (1815).

SMITH, Seba, American journalist: b. Buckfield, Me., 14 Sept. 1792; d. Patchogue, L. I., 29 July 1868. He was graduated from Bowdoin College in 1818 and entered the journalistic world as a writer for the Portland papers. Under the pen name of Maj. Jack Downing, he began a correspondence in the dialect of New England bearing upon the political issues of the day, which was continued for some time, and, having been collected and published in book form in 1833, gained considerable popularity. From 1822 to 1842 he was the editor successively of three of the Portland papers, when, having acquired a somewhat wider reputation as a political satirist, he removed to New York, where he wrote for numerous periodicals. His later published works are ‘Powhatan’ (1841), a tale of verse; ‘New Elements of Geometry,’ a parody (1850), and ‘Way Down East’ (1853).

SMITH, Sidney, English clergyman, author and wit: b. Woodford, Essex, 3 June 1771; d. London, 22 Feb. 1845. He was educated at New College, Oxford, of which he became a Fellow in 1791, and obtained in 1794 the curacy of Netheravon, a village in Salisbury Plain, near Amesbury. In 1796–1801 he was in charge of an Episcopal congregation at Edinburgh and tutor to Michael Hicks Beach. Here he continued for five years, and made the acquaintance of the most distinguished intellectual men of the day, including more especially that circle of youthful geniuses, composed of such men as Jeffrey, Horner, Walter Scott, Lord Brougham, Leyden and others. Many of them espoused with ardor liberal views in politics and literature, and with the view of disseminating these Smith proposed to his comrades the starting of a *Review*, a project entered upon with enthusiasm. Thus commenced in 1802 the famous *Edinburgh Review*, of which Jeffrey acted as editor for many years and Smith as one of its raciest and most influential contributors. In 1803 Smith removed to London, where he delivered a course of lectures on moral philosophy at the Royal Institution (1804–06), which were extremely popular, and were subsequently published. In 1806, during the reign of the Whig party, he was presented to the living of Fosbrooke, near York, in 1828 was given a prebend at Bristol and in 1831 was made canon residentiary of Saint Paul's, London. This was the utmost dignity to which he attained in the Church, it being generally believed that but for his Whig views he would have reached a bishopric. Not long afterward he came prominently forward in a series of pungent epistolary attacks on Lord John Russell, occasioned by his introduction of a bill into Parliament which materially encroached on the rights of deans and chapters. About his last literary effort was the exposure of the fraud perpetrated by the State of Pennsylvania in the repudiation of its public debts. Smith was himself a sufferer by this breach of national faith, and his sarcastic remarks on the subject excited both a little amusement in England and not a little indignation in the United States. Another characteristic publication was ‘Letters on the Subject of Catholics’ (1807–08), which was of influence in securing Catholic emancipation. A few years before his death a collected edition of his writings was published under his own superintendence. It has been said, “Smith's reputation as an English wit is solid — if that word can be applied to so volatile a quality.” He was one of the greatest of jesters and makers of *bon-mots*, but remarkable also as a thinker and English stylist. Consult Reid, ‘Life and Times of Sidney Smith’ (1884); also the ‘Memoir’ by Lady Holland; and Duyckwick, ‘Wit and Wisdom of Sidney Smith’ (1856).

SMITH, Sidney Irving, American biologist: b. Norway, Me., 18 Feb. 1843. He was graduated at the Sheffield Scientific School, Yale University, in 1867 and became assistant in zoology there. In 1871 he was in charge of the deep water dredging in Lake Superior for the United States Lake Survey, and in 1872 he was engaged in similar work for the United States Coast Survey at Saint George's banks. In 1875–1906 he was professor of comparative anatomy at Yale University, and was afterward professor emeritus. He was associated with the United States Fish Commission in 1871–87 and was elected to the National Academy of Sciences in 1884. He was an authority on American marine invertebrate zoology, and was author of numerous papers on his specialty.

SMITH, Sophia, American philanthropist: b. Hatfield, Mass., 27 Aug. 1796; d. there, 12 June 1870. Her early life was spent in comparative obscurity, but was enlivened by a rather wide range of reading and the acquisition of such desultory knowledge as she could obtain thereby. Having been early impressed with the need of women for opportunities for higher education, it was her privilege to establish the first woman's college in New England by means of a fortune left her by a brother, Austin Smith, in 1861. Smith College (q.v.) was established in Northampton, Mass., in 1875, according to plans outlined by her and by means of funds bequeathed by her in 1870 for the founding of such an institution.

SMITH, Theobald, American pathologist: b. Albany, N. Y., 31 July 1859. He was graduated at Cornell University in 1881 and took his M.D. at the Albany Medical College in 1883. He was director of the pathological laboratory of the Bureau of Animal Industry, United States Department of Agriculture, in 1884–95, and, was also professor of bacteriology at Columbian (now George Washington) University in 1886–95. He was appointed director of the pathological laboratory of the Massachusetts Board of Health in 1895, and in 1896 became also professor of comparative pathology at Harvard University. From 1911 he was a member of the consulting board of scientific experts, United States Department of Agriculture. He became an authority on infectious diseases and made many important contributions to scientific knowledge. In 1886 he demonstrated the practicability of immunizing man to cholera by injection of the filtered virus of hogs; he discovered the organism of Texas fever in *Pyrosoma bigeminum* in 1889, and with F. L. Kilborne proved that it was communicated by the tick, *Boöphilus bovis;* and in 1898 he distinguished the difference between the human and bovine tubercle bacilli, his findings being confirmed by Koch in 1900. He was elected to the National Academy of Sciences in 1908. He is author of many scientific papers and reports.

SMITH, Theodore Clarke, American historian and educator: b. Roxbury, Mass., 18 May 1870. He was graduated at Harvard University in 1892, took his Ph.D. there in 1896 and later studied at the universities of Paris and Berlin. He was assistant professor of political science at the Ohio University in 1901–03; and has since been professor of American history at Williams College. Author of 'Liberty and Free Soil Parties of the Northwest' (1898); 'Political Reconstruction' (1903); 'Parties and Slavery' (1908); 'Wars Between England and United States' (1914).

SMITH, Thomas, English scholar and diplomatist: b. Saffron Walden, Essex, 23 Dec. 1513; d. 1577. He studied at Queen's College, Cambridge, became a Fellow there, 1531, and a public lecturer, 1538; he then studied at Padua and on his return became professor of civil law at Cambridge, 1544. During these years he succeeded in changing the English pronunciation of Greek. Under Edward VI he was knighted, and served as Ambassador to Belgium and France. He lived in retirement during Queen Mary's reign, but under Queen Elizabeth was Ambassador to France, 1562–66; a member of the Privy Council, 1571; and Secretary of State, 1572. He wrote, besides two monographs on the Greek and the English languages, an important work on the Tudor constitution, called 'De Republica Anglorum' (published 1583).

SMITH, Thomas Roger, English consulting architect. He has been professor of architecture in University College, London, from 1879. Among his professional books may be cited 'Elphinstone College and the Post Office, Bombay, India.' He has published 'Handbook of Architectural History,' 'Manual of Acoustics.'

SMITH, Thomas Southwood, English reformer: b. Martock, Somerset, 21 Dec. 1788; d. Florence, Italy, 10 Dec. 1861. He was educated for the Church, but early in his ministerial career among the poor of western England was impressed with the desire for a knowledge of medicine, and the necessity for improving the sanitary conditions of the homes of the people to whom his efforts were directed. He was graduated as a physician in 1812, and in 1820 began to practise in London. In 1825 he was appointed to the London Fever Hospital, and in 1830 published his 'Treatise on Fever' which is still regarded as a most able presentation of the subject. His interest in the industrial conditions of the laboring classes of London led to an inquiry into the subject of child labor which resulted in the passage of a Factory Act and the exclusion of children from work in the mines of Great Britain. He spent much time in investigating epidemics of cholera, yellow fever, and other contagious diseases, and rendered thereby a great service to medical science.

SMITH, Uriah, American Seventh Day Adventist leader: b. West Wilton, N. H., 2 May 1832; d. Battle Creek, Mich., 6 March 1903. He studied at Harvard, became a Seventh Day Adventist and rose to great prominence in that denomination. He became editor of the *Adventist Review* at Rochester, N. Y., in 1853 and removed to Battle Creek in 1855, when the office of this denominational organ was transferred to that city. He was at the head of the great denominational publishing house at Battle Creek, a professor of Bible study in the Adventist College, and wrote many religious works, which reached a sale of 200,000 copies. Among them are 'The United States in the Light of Prophecy'; 'Daniel and the Revelation,' which attained a sale of 72,000 copies; 'The Sure Foundation.'

SMITH, William, Canadian jurist: b. New York, 25 June 1728; d. Quebec, Canada, 3 Nov. 1793. He was graduated at Yale University in 1745 and was admitted to the bar of New York. He was appointed chief justice of the province of New York in 1763, and became also a member of council in 1767, which post he nominally held until 1782. Upon the outbreak of the Revolution he was held on parole at his estate on the Hudson, but in 1778 he openly espoused the British cause, and in 1783 he went to England with the British troops. He was appointed chief justice of Canada in 1786 and held that office the remainder of his life. He established in Canada the office of constable to replace the use of soldiers in that capacity. Author 'History of the Province of New York from its Discovery in 1732' (1793).

SMITH, William, Canadian historian, son of Chief Justice William Smith (q.v.): b. New York, 7 Feb. 1769; d. Quebec, Canada, 17 Dec. 1847. He accompanied his father to England in 1783, was educated at a grammar school near Kensington and in 1786 went to Canada with his father. He was soon afterward appointed clerk of the Provincial Parliament, served also as master in chancery, and in 1814 he was appointed a member of the executive council. Author of 'History of Canada from its Discovery' (2 vols., 1815).

SMITH, William, English geologist: b. Churchill, Oxfordshire, 23 March 1769; d. Northampton, 28 Aug. 1839. After receiving an irregular education, during the course of which he displayed considerable talent for mathematics, he in 1787 became an assistant to a land-surveyor. He afterward began to act as a mining surveyor, and was led from some of his surveys of collieries to the idea of framing a model of the strata of a coal country, composed of the materials of the strata reduced to a scale, and placed in their relative positions to each other. He next began seriously to contemplate the composition of regular and extensive works on the subject of geology, and in 1815 he was able to submit a complete colored map of the strata of England and Wales to the Society of Arts.

SMITH, William Alden, American lawyer and senator: b. Dowagiac, Mich., 12 May 1859. He was a page in the Michigan house of representatives, later studied law, and in 1883 was admitted to the bar, afterward engaging in practice at Grand Rapids. He was active politically; was chairman of the State Republican Committee in 1888–92; served in Congress in 1894–1907; was elected to the United States Senate in 1906 and was re-elected in 1912. He was chairman of the Congressional Committee to investigate the *Titanic* disaster in 1912.

SMITH, William Benjamin, mathematician and New Testament critic: b. Stanford, Ky., 26 Oct. 1850. In 1871 he was graduated from the Kentucky University and in 1879 from the University of Göttingen. He taught and studied languages and sciences, 1871–76; was professor of mathematics in Central College, Missouri, 1881–85; then went to the University of Missouri, first as professor of physics, 1885–88, then as professor of mathematics, 1888–93. From 1893 to 1906 he held the chair of mathematics in Tulane University (Louisiana) and the chair of philosophy in the same institution after 1906. He published the following: 'Coordinate Geometry' (1885); 'Introductory Modern Geometry' (1893); 'Infinitesimal Analysis' (1898); 'Clew to Trigonometry' (1899); 'The Color Line' (1905) 'Des vorchristliche Jesus' (1906); pamphlets on the tariff and newspaper articles on the gold standard (1892–96); 'The Pauline Codices F and G' and other criticisms on the New Testament (1901–05); 'The Merman and the Seraph' (1906); and articles on the Bible, Calculus and New Testament problems in the ENCYCLOPEDIA AMERICANA.

SMITH, William Farrar, American soldier: b. Saint Albans, Vt., 17 Feb. 1824; d. Philadelphia, Pa., 28 Feb. 1903. He was graduated from the United States Military Academy in 1845, and was commissioned 2d lieutenant in the Topographical Engineers, and from 1846–48 was assistant professor of mathematics at the academy. At the beginning of the Civil War he served under General Butler, but later received command of a division of the Army of the Potomac, which participated in the siege of Yorktown and in the battles of Williamsburg, Malvern Hill and Antietam. He also took part in the battles of Fredericksburg (1862) and Gettysburg (1863). In 1863 he was appointed chief engineer of the Army of the Cumberland and planned the battles of Brown's Ferry and Missionary Ridge. At the close of the war he resigned from the army and became president of the International Ocean Telegraph Company and of New York board of police.

SMITH, William Henry, American journalist: b. Austerlitz, N. Y., 1 Dec. 1833; d. Lake Forest, Ill., 27 July 1896. He turned to newspaper work in 1854, being attached to the Cincinnati *Times,* first as reporter and later as managing editor. At the beginning of the Civil War he was an editorial writer on the *Gazette,* where his pen was active in the support of the government. In 1864–66 he was secretary of state of Ohio, but resigned before the completion of his second term and established the *Evening Chronicle* at Cincinnati. In 1870 he became general manager of the Western Associated Press, and in 1883, at the consolidation of the New York and Western associations, retained the general managership of the body. Meantime, in 1877, he had been appointed collector of the port of Chicago, and he was instrumental in introducing customs methods to harmonize with the civil service policy of the government. He published 'The Saint Clair Papers' (1882), a biography of Charles Hammond and a 'Political History of the United States.' During researches in the British Museum he found unpublished letters of Washington to Col. Henry Bouquet and detected errors in those published by Jared Sparks. At the time of his death he was engaged on the 'Life and Administration of President Rutherford B. Hayes,' and since his death has appeared his 'Political History of Slavery' (1903).

SMITH, William Robertson, Oriental scholar: b. 1846; d. 31 March 1894. He was the son of the Free Church minister at Keig, Aberdeenshire; was educated at Aberdeen University, where he graduated in 1865, taking the highest honors. Subsequently he spent some time at the New College, Edinburgh, and continued his German studies at Bonn and Göttingen, where his ideas upon scientific research were acquired. Thereafter, from 1868 to 1870 he acted as assistant to Professor Tait, professor of physics in Edinburgh University. In 1870 he was appointed to the chair of Hebrew and New Testament exegesis in the Free Church College at Aberdeen. His free criticism of the Old Testament writings resulted in a charge of heresy, and after prolonged discussion in the Free Church courts, during which his honesty was no less conspicuous than his learning, he was removed from his professorship in 1881. From this period he became associated with Professor Baynes in the editorship of the 'Encyclopedia Britannica,' and when the latter died he succeeded to the position of editor-in-chief. More than any other writer or researcher he emphasized the character of human editing and arbitrary rendering that has gone into the Scriptures and become classed as inspired. Meanwhile he had visited Arabia in 1879–80, where he gained an intimate knowledge of the people and their language, which qualified him to fill the position of professor of Arabic in Cambridge University, to which he was appointed in 1883. Subsequently he became a Fellow of Christ's College, and in 1886 he was elected university librarian, a post which he exchanged in 1889 for the Adams professorship of Arabic. Probably his most popular works are 'The Old Testament in the

Jewish Church’ (1881) and the ‘Prophets of Israel’ (1882). But he is best known to scholars as the author of ‘Kinship and Marriage in Early Arabia’ (1885) and his first series of Burnett lectures, ‘Religion of the Semites: Fundamental Institutions’ (1889).

SMITH, William Sooy, American army officer and engineer: b. Tarlton, Ohio, 22 July 1830; d. 4 March 1916. He was graduated from the United States Military Academy in 1853 and assigned to frontier duty. The following year he resigned his commission for more active life, and became assistant engineer of the Illinois Central Railroad. He practised the profession of an engineer in various cities of the United States until the beginning of the Civil War, when he entered the volunteer service. He was promoted brigadier-general 15 April 1862, and commanded successfully the second division of the Army of the Ohio, the first division of the 16th army corps and the cavalry division of the Department of the Tennessee, but was obliged to retire from active service on account of prolonged illness in 1864. His fame as an engineer rests upon his many improvements of the method of sinking foundations for the security of high buildings and in the use of pneumatic caissons in bridge building. His name is identified with the building of the first steel bridge, a structure which spans the Missouri at Glasgow, the construction of the Wangoshanee Lighthouse in the Straits of Mackinac, the Hudson River Tunnel and other bridge and railway work throughout the United States and Canada.

SMITH, William Waugh, American educator: b. Warrenton, Va., 12 March 1845; d. 17 Jan. 1912. He served in the Confederate army through the Civil War, and was graduated at Randolph-Macon College in 1871. He became professor of languages there in 1878, president in 1886 and chancellor in 1897. He organized the Randolph-Macon System of Colleges and Academies of Virginia, raising large sums of money for the purpose, and also founded the Randolph-Macon Women's College at Lynchburg, Va. Author of ‘Outlines of Psychology’ (1880); ‘A Comparative Chart of Syntax, Latin, Greek, German, French and English’ (1882), etc.

SMITH COLLEGE, located at Northampton, Mass. It was founded by Sophia Smith, who bequeathed $393,105 for “an institution of learning for the higher education of young women, with the design to furnish them means and facilities for education equal to those which are afforded in the colleges for young men.” The college was incorporated in 1871 and opened to students in 1875; it is unsectarian in its management and instruction. The college confers the three degrees of A.B., M.A., and Ph.D. The course includes a year's work in eight required subjects, including Bible study, a major study consisting of related courses in the junior and senior years, two three-hour courses in the junior and senior years, one of which must be in a department entirely different from the major study, and free electives to complete the required number of hours. The curriculum includes music and art, and a certain amount of technical work in each department when combined with theoretical courses counts toward the degree. Formerly the departments of music and art were organized as separate schools, but in 1902 were co-ordinated with the other collegiate studies. The college was among the first to recognize music and art among the qualifications for the degree. A number of scholarships are provided, the largest of which has a fund of $10,000; there are also fellowships for advanced work in philosophy and psychology, botany and zoology; and the college aids in the support of the American women's table at the zoological station at Naples, entitling graduates to appointment to this station. Likewise two tables are maintained at the seaside laboratories for the advanced study of zoology and botany. Physical training is required of students, and much interest is also taken in outdoor sports. The college has a large and beautiful campus, including the botanical gardens; the buildings (in 1904) are College Hall, Seelye Hall, the John M. Greene Hall, Lilly Hall of Science, Chemistry Hall, the Library, the Observatory, Music Hall, the Hellyer Art Gallery, the Alumnæ Gymnasium, the Infirmary, the Lyman Plant House, the Botanic Garden, the Students' Building, the centre of the students' social life, with a large hall, rooms for clubs, etc., and a reading-room, and 18 dwelling-houses. The library contains about 70,000 volumes, and the Northampton Public Library and the Forbes Library are also open to students. The productive funds in 1917 amounted to $2,242,591, the students numbered 1,946 and the faculty 205. In the European War, Smith College sent a body of students to do reconstruction and canteen work in France; and maintained courses of instruction for laboratory assistants, and a two years' course for training assistants, in neurological hospitals for the treatment of nervous debility and shell shock among returned soldiers.

SMITH-LEVER AGRICULTURAL EXTENSION ACT, an act passed by the United States Congress in 1914 to provide extra-mural instruction and to diffuse among the American farmers agricultural information. See AGRICULTURAL LEGISLATION.

SMITH SOUND, a passage of water at the northern extremity of Baffin Bay, between Peary Land, in Greenland, and Ellesmere Land. It leads from Baffin Bay into Kane Basin, a body of water about 110 miles long. Its southern entrance was discovered by Baffin in 1616. In 1854 it was surveyed by a United States expedition under Dr. Elisha Kent Kane.

SMITHFIELD, a historic square in London, a little north of Newgate and west of Aldersgate, which was until 1855 the only cattle market in London. It was outside the old city walls and in the 11th century was an open spot where the citizens delighted to promenade. Before the days of Tyburn, Smithfield (now called West Smithfield to distinguish it from East Smithfield, Tower Hill) was the place of public execution. Here Sir William Wallace and Mortimer, Earl of March, suffered death; here Walworth, the mayor, stabbed Wat Tyler; and here Jack Straw was hanged. Tournaments were held on this spot; Edward III celebrated the deeds of Cressy and Poitiers by mimic feats of arms here; and here Richard II gave a three days' tournament to celebrate his marriage. A more terrible page of history tells of the murders by way of burning which took place here in the name of religion. Bartholomew Fair, so often mentioned in literature, was held at Smithfield. We find mention of a cattle market having been held here as far back as 1150. The corporation had official control over the market for above 500 years, dating from 1345.

SMITHFIELD (W. Va.), **Engagement at.** This place, near the east bank of the Opequon, on the road from Charlestown to Bunker Hill, W. Va., was the scene of many skirmishes and minor engagements during the Civil War, one of which, at least, deserves to be noted. On 28 Aug. 1864, after General Early had recrossed the Opequon from his engagement at Shepherdstown (q.v.), General Sheridan advanced his army from Halltown toward Charlestown and the Opequon. General Merritt's cavalry division marched by way of Lee Town, attacked Fitzhugh Lee's cavalry at that place and drove it through the village, back through Smithfield and across the Opequon. Next morning Merritt crossed the Opequon and was on his way to attack Early at Bunker Hill, when he was met by Early, with the divisions of Ramseur and Gordon and driven back across the Opequon. There was an artillery duel across the stream and, the Confederate cavalry crossing, Merritt was driven from Smithfield and two miles beyond, in the direction of Charlestown. Early re-established his cavalry east of the Opequon and marched his infantry back to Bunker Hill. Late in the day Ricketts' division of infantry came to Merritt's assistance and drove the Confederate cavalry from Smithfield and across the Opequon and Merritt resumed his position at the Smithfield bridge. The Union loss was about 35 killed and wounded; the Confederate loss, 10 killed and 75 wounded.

SMITHSON, James, founder of the Smithsonian Institution at Washington: b. Weston, Super-Mare, Somerset, England, about 1765; d. Genoa, Italy, 27 June 1829. His mother at the time of his birth was the widow of James Macie, a country gentleman of an old family. Smithson describes himself in his final will as «son to Hugh, first Duke of Northumberland, and Elizabeth, heiress of the Hungerfords of Studley, niece to Charles the Proud, Duke of Somerset.» Smithson seems himself to have observed no reticence about what he thought the true facts of his birth, but the name of Macie appears to have been imposed upon him from his youth by his parents and his feeling that he must create for himself a position which his birth had denied him is perhaps a reason for his subsequent bequest to the United States of the means which founded the institution bearing his name which he had later assumed and which was the family name of Sir Hugh Smithson, the first Duke of Northumberland. It cannot but be supposed that something of this kind was in his mind when he wrote «My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten.»

Nothing material is remembered of his life at Oxford, where he entered under the name of Macie as a gentleman commoner in 1782, though he appears to have been partly occupied in chemistry, which was the scientific interest of his later life, and this at a time when the study of physical science was almost unknown in the university. He was graduated at Pembroke College with the degree of master of arts in 1786 and was admitted as a Fellow of the Royal Society in the following year on the recommendation of Cavendish and other eminent fellows of the Society. Smithson published in all 27 scientific papers, eight in the Philosophical Transactions between 1791 and 1807, one in the *Philosophical Magazine* and 18 in 'Thompson's Annals of Philosophy' between 1819 and 1825.

Prof. F. W. Clarke gives the following view of the value of Smithson's scientific work:

«To theory Smithson contributed little, if anything; but from a theoretical point of view the tone of his writings is singularly modern. His work was mostly done before Dalton had announced the atomic theory and yet Smithson saw clearly that a law of definite proportions must exist, although he did not attempt to account for it. His ability as a reasoner is best shown in his paper upon the Kirkdale bone cave which Penn had sought to interpret by reference to the Noachian deluge. A clearer and more complete demolition of Penn's views could hardly be written to-day. Smithson was gentle with his adversary, but none the less thorough for all his moderation. He is not to be classed among the leaders of scientific thought; but his ability and the usefulness of his contributions to knowledge, cannot be doubted.»

An important ore of zinc was named Smithsonite after him.

That he held a high place among his contemporaries is evident from the fact that the president of the Royal Society in a necrology for the year 1829 associated the name of Smithson with those of Wollaston, Young and Davy, saying that «he was distinguished by the intimate friendship of Mr. Cavendish and rivaled our most expert chemists in elegant analyses.» He was, then, most noted in this connection, and exhibited an industry the more creditable to him, since he was at this time a man of large means. Of Smithson's later life little is known, but his declining years appear to have been tried by painful infirmities. He lived in these years principally in Paris and Genoa and one gathers from his letters and from the uniform consideration with which he speaks of others and from kind traits which he showed, the impression of an innately gentle nature, but also of a man who was renouncing, not without bitterness, the youthful hope of fame.

Smithson's will, dated from London 23 Oct. 1826, is a brief document leaving his property to a nephew and in the case of the death of the nephew without leaving a child, he adds: «I then bequeath the whole of my property to the United States of America to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men.»

The will was proved in the Prerogative Court of Canterbury, the value of the effects being sworn to be not over £120,000, a sum much larger in relative importance at the time than it would be now. The money appears to have come from his mother's family; there is, at least, no indication that any portion whatever of the Smithson bequest was derived from his Northumberland ancestry. It is not definitely ascertained why Smithson made the United States his legatee, in which he is not known to have had any correspondent or friend.

Smithson was buried in the little English cemetery on the heights of San Benigno, the remains and monuments in which are now being removed by the Italian government to another location. The regents of the Smithsonian Institution, who had caused a tablet to be erected to him in the cemetery and in the church, on the removal of the cemetery, appointed one of their number, Dr. Alexander Graham Bell, to bring the remains from Genoa to Washington, where they arrived in the early part of 1904 and were later interred on the grounds of the Smithsonian Institution. Consult Rhees, 'James Smithson and His Bequest' (in Vol. XXI, Smithsonian Miscellaneous Collections); Langley, 'James Smithson' in 'The Smithsonian Institution, 1846–1896. The History of Its First Half Century' (1897).

S. P. Langley,
Late Secretary, Smithsonian Institution.

SMITHSONIAN INSTITUTION, The, an establishment at Washington, founded under a bequest of James Smithson (q.v.), couched in the following terms: «I bequeath the whole of my property to the United States of America to found at Washington under the name of the Smithsonian Institution an establishment for the increase and diffusion of knowledge among men.»

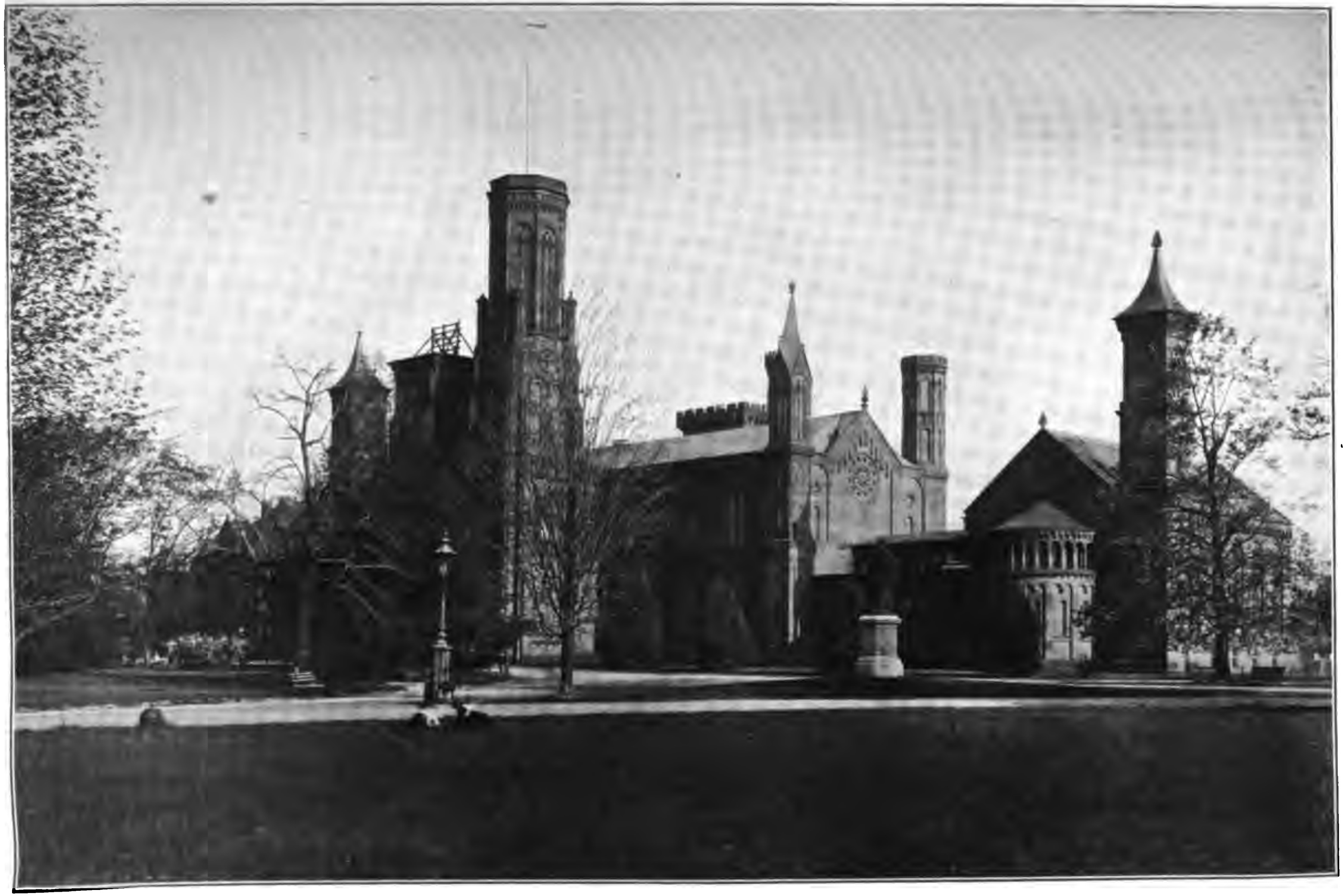
In 1835, six years after Smithson's death at Genoa, Italy, the United States legation at London was notified that his estate, amounting in value to about £100,000, was held in possession of the accountant general of the British Courts of Chancery. President Jackson, in a message to Congress, dated 17 Dec. 1835, notified that body and after considerable debate a bill was passed and approved on the 1st of July 1836, authorizing the President to assert and prosecute the claim of the United States to the legacy, which it is well to note was relatively of greater purchasing power then than now, being greater than the endowment of any university or college in the country except Harvard at that time. The President selected as agent Richard Rush of Pennsylvania, who proceeded to London and entered a friendly suit in the Courts of Chancery, which was settled in two years. For eight years the matter was discussed in Congress, until on 10 Aug. 1846 an act which had passed both Houses was approved by the President, in terms so broad as to allow for any future development of the institution along any lines of intellectual advancement.

System of Administration.— The establishment consists of the President of the United States, who is the presiding officer ex officio; the Vice-President, the chief justice of the United States and the members of the Cabinet. In addition to the establishment, there is provided a board of regents, by whom the business of the institution is administered, composed of the Vice-President of the United States, the chief justice of the United States, three members of the Senate, three members of the House of Representatives and six citizens, two of whom must be residents of the District of Columbia, and the other four from States of the Union, but no two from the same State. The senatorial regents are designated by the president of the Senate and those representing the House by the speaker of the House, the others being elected by Congress with the approval of the President. There is a secretary to the establishment, who is also secretary to the board of regents. Both the Congressional and citizen regents have been selected from among the most distinguished Americans and the roll of them for 50 years contains the names of many eminent public men and scholars. The regents elect three of their number as an executive committee. The presiding officer of the regents is the chancellor and is elected by the board, though the position is customarily held by the chief justice. The secretary of the institution, whose office is created by the fundamental act, is elected by the regents and is the executive officer of the institution. He is aided in his work by the assistant secretary, by the heads of the various bureaus of the institution and by a large corps of scientific men.

The institution occupies a building in the Mall, in the square known as the Smithsonian Park. It was planned by James Renwick, was begun in 1847 and completed in 1855.

The first secretary was Joseph Henry, distinguished in science for his epoch-making discoveries. It fell to his lot more than it could to any of his successors to determine what form the institution should take and his «Programme of Organization,» adopted at the outset by the board of regents as the governing policy, has been found broad enough for all future time. Upon his death he was succeeded in 1878 by Spencer Fullerton Baird, the leading authority on the natural history of America, and the founder of the United States Fish Commission, and upon his death in 1887 Samuel Pierpont Langley was elected, to be succeeded by Charles D. Walcott. The terms of each of these men have been marked by some special feature — Henry developed the system of international exchanges and that of meteorological observations, which has since become the Weather Bureau; Baird devoted himself to the development of the Museum, secured the erection of a Museum Building, gave much attention to explorations and, as United States Commissioner of Fish and Fisheries, secured the construction of the exploring ship *Albatross,* which has been of such great advantage to American science. In the term of Langley, the National Zoological Park and the Astrophysical Observatory were established, and a new building authorized for the National Museum. Langley's special contribution was in the demonstration of mechanical flight by a machine heavier than the air, propelled by its own power. «Langley Field,» devoted to experiments in aviation, was established near Hampton, Va., as a direct result of his researches. The recent activities of the institution covered geological explorations in the Canadian Rockies by the present secretary, palæontological research in the Appalachian and Ohio valleys by Dr. R. Bossler and Mr. C. Resser, and in Florida by Dr. Sellards and Dr. Hrdlička. Extensive biological and botanical work was carried on in Cuba, Haiti, the Hawaiian Islands, China, Santo Domingo and Celebes. A botanical station was also established at Jamaica, devoted to the study of West Indian specimens. In 1917 an expedition under Collins and Garner left to explore the French Kongo and adjacent territories.

National Research Council.— This body was organized in 1917 and consists of scientists devoted to research. After the declaration of



THE SMITHSONIAN INSTITUTION AT WASHINGTON, D. C.

JAMES SMITHSON

Founder of the Smithsonian Institution

war by the United States, this council was called upon to co-operate with the Council of National Defense, and several of its committees were given special accommodations under the latter council: notably the committees of chemistry, engineering, medicine, hygiene, physics, agriculture and psychology. A foreign service committee was also organized as a «direct aid in acquainting investigators in this country with the scientific problems which have been confronted both in military and industrial pursuits in England and France.»

Objects of the Institution.— The broad purposes of the institution are named in the words of the founder — «for the increase and diffusion of knowledge among men.» This was interpreted by Henry in the following words: «To assist men of science in making original researches, to publish them in a series of volumes, and to give a copy of them to every first-class library on the face of the earth.» It has supplied apparatus, made grants for experiments and furnished information to many thousands of persons. The institution also maintains a table at the biological station at Naples. It initiated, from the income of its own fund, all of the activities imposed upon it by the fundamental act, though as these gradually grew beyond this income, they were greatly aided by appropriations from Congress, through which the various bureaus are at present maintained.

Publications.— There is no restriction as to the subject of publications, and they consist of memoirs upon archæology, astronomy, ethnology, botany, zoology, geology, palæontology, meteorology, magnetics, physics, physiology and philology and many other branches of investigation. They cover the following series: (1) 'Annual Report of the Regents to Congress.' Since 1884 the 'Report of the Museum' has been printed in a separate volume, Part II. (2) 'The Smithsonian Contributions to Knowledge'; (3) 'The Smithsonian Miscellaneous Collection,' 28,000 pages. A 'Quarterly Issue' of this series was begun in 1903. The foregoing publications are maintained at the expense of the original fund; (4) 'The Bulletins of the National Museum,' 52 in number, beginning in 1875; (5) 'The Proceedings of the National Museum,' beginning in 1878. (6) 'The Annual Report of the Bureau of American Ethnology,' beginning in 1879; (7) 'The Bulletin of the Bureau of American Ethnology'; (8) 'The Annals of the Astrophysical Observatory'; (9) 'Reports of Historical and Patriotic Societies.' In 1897 a royal octavo volume containing the history of the first half century of the institution was published.

Library.—The publications noted above have been, since the beginning, distributed throughout the world, mostly to scientific and literary establishments and libraries; and in return the institution has received the publications of like organizations, forming a collection of books which in the departments of publications of learned societies and periodicals is one of the richest in the world. In 1865 the library was deposited with the Library of Congress and is now installed in a special hall upon the second floor of the new Library building. A working library of some 30,000 volumes has gradually grown up in connection with the institution and its dependencies. Much attention was given to cataloguing and bibliography by the first assistant secretary of the institution, Charles C. Jewett. Henry likewise was greatly interested in this subject, and it was due to his initiative that the Royal Society of London took up its catalogue of scientific memoirs, which has since developed into the International Catalogue of Scientific Literature. For this latter work the Smithsonian Institution is the representative of the United States. In addition to the main Smithsonian Library, smaller collections are maintained in the various branches of the institution and 35 sectional technical libraries in the various offices for the use of the scientific staff.

The collection of objects of art was one of the original purposes of the institution, though it has been to some extent held in abeyance. The valuable collection of prints and art books of George P. Marsh was, however, purchased, and a room devoted to prints and art books is set aside in the Smithsonian building.

National Museum.— The Smithsonian Institution is the only lawful custodian of «all objects of art and of foreign and curious research, and all objects of natural history, plants and geological and mineralogical specimens belonging, or hereafter to belong, to the United States, which may be in the city of Washington.» Out of this provision in the fundamental act there grew the National Museum. See UNITED STATES NATIONAL MUSEUM.

International Exchanges.— The system of international exchanges, begun in 1850, was designed for a free interchange of publications between men of science in various parts of the world. It established a body of correspondents which now numbers nearly 44,000, mostly abroad. In 1867 Congress assigned to the institution the duty of exchanging for the benefit of the Library of Congress 50 sets (a number since increased to 100) of all government publications, and in 1889 a treaty was entered into between the United States and other countries, in which this entire matter of exchange of scientific and government publications was fixed. This branch of the service, while not having a large space in the public eye, has been of great convenience to scientific men, of use in developing the libraries of this country, and indirectly has stimulated scientific research and publication, since by relieving scientific societies and individuals of the expense of exchanging their own publications, it has set large sums of money free for research. During the war in Europe it became necessary to suspend shipments to about 10 countries.

Bureau of American Ethnology.— This bureau is an outgrowth of researches beginning early in the history of the institution, whose first publication in the series 'Contributions to Knowledge' was on 'Ancient Monuments in the Mississippi Valley,' by Squier and Davis. In its present form the work of the bureau was commenced in 1872 by Maj. J. W. Powell, at the request of the Commissioner of Indian Affairs, who desired trustworthy information concerning the affinities of the Indian tribes. In 1879 the bureau was definitely organized under the direction of the Smithsonian Institution, and Major Powell was made director, serving in that capacity until his death in 1902. The bureau has engaged in researches in the languages, habits, customs, tribal organizations, government, myths and ceremonies of the American Indians, and it is proposed to summarize this material in a cyclopedia of American Indians. It has also issued the voluminous publications already alluded to, which contain information of importance with regard to the political dealings of the United States government with the Indian tribes. In addition, researches are conducted among the natives of Hawaii.

Astrophysical Observatory.— The Astrophysical Observatory was established in 1890 under the immediate direction of the present secretary. It has been devoted, in the main, to researches in regard to that invisible portion of the solar spectrum which lies beyond the limit of the red. This work, first rendered possible by Mr. Langley's invention of the bolometer, has been carried still further, resulting in a great map of the infra-red solar spectrum completed in 1899, which extends our knowledge of the spectrum to many times that known to Newton. It is believed that these studies will prove of great practical importance, since they have to do with that region of the spectrum which includes the greater portion of the energy of the sun, which through its heat affects climate and crops. Important expeditions were sent out in 1900 and 1901 to observe the total solar eclipses of those years, and especially valuable results were obtained at that of 1900, including photographs of the solar corona of unexampled size and excellence. An expedition was planned to enlarge the work of measuring solar radiation, by establishing a station in South America. Owing to war conditions this has been stationed temporarily at Hump Mountain, N. C. (1917).

National Zoological Park.— The National Zoological Park was established by Congress in 1890 at the initiative of the present secretary, to secure the preservation of such American animals as are upon the verge of extinction, and also for the pleasure and instruction of the people. The park is situated upon Rock Creek, two miles north of the centre of the city, and has an area of 167 acres, being four times as large as the Zoological Garden at London. It is amply supplied with water, and its surface is of a varied and picturesque character. The collection comprises 1,225 animals, mostly American species. A hospital and laboratory were established in 1917.

Summing up what has been said about the Smithsonian Institution, we see that it occupies the exceptional position of a ward of the government, its regents expending its own income, which is largely supplemented by direct government grants for its museum and other bureaus; while through its extended system of publications, its library and its means for encouraging research and diffusing knowledge, through a body of over 30,000 correspondents abroad and approximately half that number at home, it occupies its actual place in the scientific activities of the day.

Consult ‘The Smithsonian Institution, 1846–96, the History of its First Half Century,’ edited by George Brown Goode; and subsequent Annual Reports.

SMITHSONITE, *in mineralogy,* native carbonate of zinc ($ZnCO_3$). It crystallizes in rhombohedral system with perfect cleavage, and is found also in reniform botryoidal and stalactitic masses; and again granular to compact massive or earthy. In this latter form it is impure and varies from grayish-white to dark gray-brown, brownish-red or brownish-black, and is known as “dry bone” by American miners. In the purer forms it has a vitreous lustre inclining to pearly with the color varying from white to grayish, greenish or brownish, a white streak and a translucent to almost transparent character. Its hardness is 6 per cent the scale, and its specific gravity 4 to 4.45. In the United States it occurs in New Jersey, near Franklin Furnace, Pennsylvania, Wisconsin, Minnesota, Missouri, Arkansas and other States. The name is also sometimes applied to calamite ($H_2Zn_2SiO_5$), which is a yellowish or brownish zinc silicate, and an important ore.

SMITHWORK. See METAL WORK.

SMOCK, John Conover, American geologist: b. Holmdel, N. J., 21 Sept. 1842. He was graduated at Rutgers College in 1862 and later studied at the Mining School, Freiburg, and at the University of Berlin. Since 1871 he has been professor of geology at Rutgers. He was connected with the geological survey of New Jersey in 1864–85; was State geologist in 1890–1901; and in 1901–15 he was a member of the board of managers of the New Jersey Geological Survey. Author of ‘The Climate of New Jersey’ (1881); ‘Building Stone in New York’ (1888); ‘Geological Survey of New Jersey’ (Vols. III, IV), etc.

SMOHALLA, shmō'hä'lạ (correctly SHMOQŬLA, “The Preacher”), American Indian prophet and religious leader: b. about 1815; d. 1907. He was of the Sokulk tribe, cognate to the Nez Percés, and living near the Priest Rapids on the Columbia River in eastern Washington. He early received religious instruction at a Roman Catholic mission, afterward became a warrior and about 1850 began to preach. He then wandered away from his people, reached as far south as Mexico and returned through Nevada. He announced upon his return that he had been absent in the spirit world and had returned with a message. The Indians were commanded by the Great Spirit to return to their native manner of living, have no dealings with the whites, retain their land and live according to the will of the Great Spirit as revealed by Smohalla, who received such communications while in a trance. The cult became known as the “Dreamers” and gained a great following, including Chief Joseph and his tribe, the Nez Percés, and eventually became sufficiently strong to interfere with government reservation rulings. Investigations were made in 1870 and again in 1884 with a view to keeping the Dreamers within legal bounds.

SMOKE, the exhalation or visible vapor that arises from a substance burning. In its more extended sense the word smoke is applied to all the volatile products of combustion, which consist of gaseous exhalations charged with minute portions of carbonaceous matter or soot; but, as often used in reference to what are called smoke-consuming furnaces, the term is frequently employed to express merely the carbonaceous matter which is held in suspension by the gases. The flames from burning metallic substances are also called smoke. With forced draft there is a great deal of waste in smoke, and engineers have given great study to the problem of reducing such waste, and wholly consuming the fuel, especially coal. A variety of contrivances, known as smoke-consumers or smoke-burners, have been introduced for this purpose. (See SMOKE NUISANCE). When the U-boats began to be dangerous to shipping, navigators turned their attention to means of producing a very thick and heavy smoke, which would screen a vessel from observation, and render it impossible for an enemy to aim with accuracy, not knowing where within the smoke their target was located.

SMOKE ('Duim'). Although Turgénief usually spent a part of every year in Russia, his home from 1863, the year following the publication of 'Fathers and Sons,' was in Baden-Baden until 1870. He was so disappointed by the harsh criticisms of his novel, by the way it was misunderstood and by the consequent coldness of former friends that he even contemplated abandoning literature. But in 1867 'Smoke' appeared in the *Russky Vyestnik*, again arousing great animosity and bringing against him charges of caricaturing the young generation, and of insulting his own country. Some thought that its satire was an act of revenge. The scene is laid at Baden-Baden, whither come the various characters, always chattering, without, as he expresses it, a single word of sincerity, a single intelligent thought, a single new fact amid all the incoherencies; with no enthusiasm, no genuine passion but pseudo-civic indignation, pseudo-scornful indifference. The leading character, Grigory Mikháïlovitch Litvínof, of decent family and moderate means, is in Baden awaiting the arrival of his cousin, Tatyána Petróvna Shéstova, who is to be his wife. Litvínof is discovered by a Moscow acquaintance, who insists on introducing him to every Russian in Baden, and this enables Turgénief to indulge in his bitterest satire. Litvínof encounters his former fiancée, Irína Pávlova, now married to General Ratmírof. By the time Tatyána Petróvna arrives, Irína has succeeded in throwing her malign fascination upon him. He breaks with his cousin, and is ready to elope with Irína, but their plan fails, and he leaves Baden-Baden competely disillusioned. As the train bears him away, the smoke and steam from the engine drift by the window, now hiding the landscape, now giving a glimpse of gray skies and the misty Rhine Valley: "He was alone in the carriage, with no one to interrupt him. 'Smoke! smoke!' he said to himself several times. And suddenly everything seemed to him to be smoke — everything, his own life, everything human, especially everything Russian. 'Everything is smoke and steam,' he thought, 'everything seemingly goes through constant change; everywhere there are new forms, phenomenon succeeds phenomenon, but in reality all things are exactly alike; everything is rushing to some unknown end and everything vanishes, leaving no trace. . . .'" And as he recalls the heated arguments, the futile chatter of his expatriated fellow-countryman, he realizes that his own aspirations and feelings are merely smoke like everything else.

The interest of the story centres on Irína, who is typical of the brilliant unscrupulous man-chaser, cold and calculating, the Vampire of Society, made so by her environment and by false education. Litvínof is pallid in comparison with Bazárof and not so fresh and charming as Arkády. The other characters are individual, but none of them is interesting except as illustrating the ebullient Russians of the early sixties. 'Smoke' was translated into English under the title 'Smoke, or Life at Baden' (anonymous, London 1868); by W. F. West from the French version (1873). It is also in the five-volume edition of Turgénief's 'Works' (London 1874–75). It is to be found in Mrs. Constance Garnett's complete edition of the works from the Russian in 15 volumes (London 1894–99), and in Miss Isabel Hapgood's version (New York 1904), also from the original. None is very satisfactory as representing the literary perfection of the author's style.

NATHAN HASKELL DOLE.

SMOKE-BALL, a ball filled with a slow-burning composition, that emits a dense smoke, used by the navy to blind an enemy and mislead their fire.

SMOKE NUISANCE. Various measures have been taken both in England and the United States to overcome the evil effects of soft coal smoke, especially in large cities. In 1875 a Public Health Act was passed in England to prevent nuisance from smoke in towns which provided that all fireplaces, furnaces and chimneys (exclusive of the chimneys of a private dwelling) must be so constructed as to consume their smoke, under a penalty not exceeding $25 nor less than $10, on a second conviction $50. Similar laws apply to railway locomotives and river steamers. In the United States various laws have been passed by State legislatures and ordinances by municipal bodies. But these enactments have only been partially successful. There are many practical difficulties in the way of consuming smoke, but experience has shown that none of them are insuperable. The principle involved is that of mixing air with the combustible vapors and gases generated by the action of heat on the fuel, so that by virtue of a due supply of oxygen at the correct temperature they may be made to burn with flame, and become entirely converted into incombustible and invisible vapors and gases. The increased use of gas and electricity tends toward a solution of the problem in cities. Consult Popplewell, 'Comsumption of Smoke'; Mellon, 'Smoke Investigation Bulletins' (Pittsburgh 1912, 1913, etc.); Barr, W. M., 'The Combustion of Coal and the Prevention of Smoke' (New York 1913).

SMOKE-STACK, a stack or funnel, usually of sheet steel, placed on boilers, locomotives, etc., to carry off the gases of combustion. Also the tall draft-chimney of a factory, smelter, etc.

SMOKE-TREE, an arborescent shrub (*Cotinus*, or *Rhus cotinus*) indigenous to Europe, and also called Venetian Sumach; or the similar American species (*Cotinus cotinoides*). They are shapely, tall and much branched and have oval leaves and terminal, large, loose panicles of greenish, polygamus five-parted flowers. These are chiefly abortive, and the long pedicels become very plumose in fruit, and seem to smother the plants as by smoke, with their feathery soft masses, which are pale green or reddish in hue. The soft orange-colored wood yields a valuable dye-stuff called young fustic, and the leaves of the European species are used in tanning. Other names are the mist-tree and smoke-plant.

SMOKELESS POWDERS are the modern explosives which have replaced black gunpowder for use as propellents in guns. Such powders are styled smokeless because they give rise to comparatively little smoke when fired. This is due to the fact that the products of their combustion are practically all gaseous at the temperature of explosion. Black gunpowder gives rise to much smoke when fired because 57 per cent by weight of the products of its combustion form solid matter on cooling and, therefore, precipitate rapidly out of the atmosphere. While smokelessness or smoke-weakness offers, for many military purposes, the distinct advantage that it permits of a clear atmosphere being maintained during an engagement; that it delays the enemy in locating the spot from which a shot was fired; and that such powders do not readily foul the bores of the guns in which they are used, these modern powders possess the still more important advantage that weight for weight, they are much more powerful than black gunpowder. In consequence of this we not only by their use are able to impart higher velocities to our projectiles and thus secure flatter trajectories, greater ranges and better penetrations than were before possible, but the soldier or the ammunition wagon now carries less weight for the same number of rounds of ammunition or a greater number of rounds of ammunition for the same weight. The earliest experiments with smokeless powder were made by the English chemist, Howard, in 1800, when he tested the properties of his newly-discovered mercuric fulminate and found that though this violent agent produced little smoke, imparted a low velocity to the projectile and but a slight recoil to the piece, it burst the chamber and demonstrated its unfitness to compete with gunpowder as a ballistic agent, though it has found a limited use, when mixed with solid diluents which act as restrainers, in ammunition for parlor rifles, and it is noticeable that when firing this ammunition there is little smoke and a scarcely audible report attending the discharge.

The next step was taken when, soon after the discovery of guncotton, in 1845, attempts were made to use this material, in its fibrous condition, as a propellent. These experiments were made in Germany, France and England, while a very extended series were carried on by Major Mordecai of the United States army, at the Washington arsenel; but the material, owing to its fibrous form and the imperfection in its manufacture, proved too brisant and too irregular in action and it was so unstable as to undergo dangerous decomposition in storage so that it was not adopted. The material had, however, been proved to possess so many valuable qualities that it continued to be the subject of study by many chemists and especially Baron von Lenck of Austria and Sir Frederick Abel of England, the latter devising a method of purification by reducing the guncotton to a pulp or dust. Besides affording a means for the better washing of the guncotton this pulverulent condition permitted of the dust being formed into grains and a patent was issued to Abel in 1866 for the production of powder by agitating this pulp in a vibrating vessel, with or without a binding material, whereby the pulp was formed into granules of different sizes which were subsequently sorted. The grains thus produced were quite soft, easily crushed when dry and readily absorbed water. In 1882 Reid and Johnson of England improved the process by moistening the dried grains with a volatile solvent which on evaporation left the surfaces so hardened as to better resist crushing and the absorption of water from the atmosphere. During this time superficially hardened soft grained powders composed of mixtures of different cellulose nitrates or nitro-lignins together with unnitrated material and nitrates such as sodium or barium nitrates came into use as smokeless sporting powders under the names among others of Schultze, E. C., Brackett's, J. D., and American Wood powders. These powders were, from the method of their manufacture, quite bulky and are, therefore, also classified as bulk powders.

In 1886 Vielle in France produced the first military smokeless powder of the modern class, by gelatinizing a mixture of cellulose nitrates only, or these mixed with barium and potassium nitrates as oxidants and sodium carbonate as a neutralizer, with ether-alcohol or some other solvent. When the solids and the solvents were intimately mixed and gelatinization was complete the plastic mass was rolled out into sheets, cut into strips and dried, by which a dense powder, which was hardened throughout, was produced. This powder was styled Poudre B when it consisted of cellulose nitrates only or Poudre BN when it consisted of these nitrates mixed with the inorganic salts named above. In 1888 Nobel in France discovered that by the aid of camphor or benzine he could effect the solution of as much as 40 per cent of nitro-cotton in nitroglycerin, forming a plastic mass which when rolled out into sheets and dried formed a mass resembling india rubber. This was cut in blocks or strips or flakes and was known as ballistite. As adopted in Italy the plastic mass was squirted through spaghetti machines forming cords which were cut into the desired length and the powder in this form was known as Filite.

In 1889 Abel and Dewar in England made a plastic mass from nitroglycerin, nitro-cotton, guncotton and tannin, dextrine or vaseline, and as it was made up into cords, it was called Cordite. In making this powder the gelatinization was effected by using acetone as a solvent, the mixture being kneaded to a dough in a water-jacketted kneading machine. The gelatinized mass was compacted in a mold by a preliminary press, and the mold transferred to a spaghetti machine, or stuff press, where the explosive was squirted into strands. As these strands issued they were reeled on bobbins which were placed in the drying house so as to drive off the solvent. When dried the product of 10 pressings was wound from 10 one-strand reels on to one 10-strand reel and then the cordite on six 10-strand reels was wound on a drum making a cord of 60 strands, which when cut in short lengths formed the 30.5 grains charge for the magazine rifle. For higher calibres the cords as squirted were of larger diameter and were cut into desired lengths as they issued from the stuff press, dried and made up into bundles or fagots. Cordite is an elastic rubber-like mass with a light to dark brown color. Other nitroglycerin-cellulose nitrate powders are amberite, Maxim's powder, Maxim-Schupphaus powder, Leonard's powder, P. P. G., Peyton's powder and German smokeless powder. These powders differ in the proportions of their ingredients or in containing blended cellulose nitrates, or else castor oil or lycopodium or urea in addition to the other ingredients or they differ in the form of the grain. Thus Maxim perforates his grain, making it a tube, or he makes several longitudinal perforations, getting «multiperforated grains,» while Gathmann cuts slots in the sides of the multiperforated grain to serve as vent holes through which the gases accumulated in the longitudinal canals may escape, and the breaking up of the grains by the accumulated pressure be prevented.

In 1890 Richard von Freeden of Walsrode, Germany, discovered that gelatinized cellulose nitrate if immersed in water underwent a kind of coagulation and division into small lumps which latter was promoted by stirring, and he based upon this a method of manufacture by which dense small grained powders that are hardened throughout could be produced. This product is known as Walsrode powder. Later Dupont accomplished the same result by throwing his pulped cellulose nitrate into a churn containing the gelatinizing solvent mixed with a large volume of water and containing potassium and barium nitrates in solution, and thus produced the Dupont smokeless powder. Similar to these, and likewise used for sporting purposes, are the Oriental and Hazard smokeless powders. In 1890 Charles E. Munroe pointed out that all powders, either gunpowders or smokeless powders made up to that time, consisted of mixtures of different materials, even the straight cellulose nitrate powders being made of mixtures of different nitrogen contents, and he set forth the novel principle of powder making that the finished powder should consist of a single chemical substance in a state of chemical purity and this was realized in the smokeless powder which he styled Indurite and which was popularly known as United States Naval smokeless powder. As made it consisted only of cellulose nitrate of the highest nitration in an indurated condition and resembled ivory. It was made in the form of flakes for small arms and in the form of macaroni for large calibres. The smokeless powder for the United States navy and army as made to-day consists of cellulose nitrate of medium nitration, gelatinized with ether-alcohol, a small percentage of diphenylamine being incorporated to serve as a stabilizer, the ether-alcohol evaporated and the plastic mass made into perforated cylindrical grains which are translucent and the color of amber. Because of the shortage of cotton during the Great War pulp wood was resorted to as a source of cellulose for smokeless powder, and very satisfactory powder was made from it in the United States and Germany.

Flashless Powder.— When smokeless powder is fired it gives a much more brilliant flash than ordinary gunpowder does and therefore when discharged after dark the position of a piece may be located by this flash. Because of the superior intensity of sunlight this flash is not ordinarily perceived by the naked eye during daylight but during the Great War light screens have been devised by which to sift out this flash light from the sun light so as to locate the gun. To defeat this chemicals have been introduced into the powder by which to reduce or obscure the flash. The sodium and potassium resinates were so used but amids and carbonates have been found still more efficient.

Progressive Smokeless Powder.— With increasing calibres and lengths of guns it becomes of increasing importance to secure a progressive rate of burning of the powder grains so that after the projectile has been moved from its seat it shall be given a constantly increasing acceleration as it traverses the chase. The powder grains are perforated and their density varied with a view of securing this result but, since with large calibres these are insufficient, the coating of the grains with restraining substances has been resorted to, very good results having been obtained with dimethyl-diphenyl-urea which substance is for convenience styled «Centralite.»

Bibliography.—Longridge, 'Smokeless Powder and Its Influence on Gun Construction' (1890); Moch, 'La poudre sans fumée et la tactique' (Paris 1890); Rigg and Garvie, 'Modern Guns and Smokeless Powder' (1892); Pouteaux, 'La poudre sans fumée et les poudres anciennes' (Paris 1893); Guttmann, 'The Manufacture of Explosives' (1895); Munroe, 'Development of Smokeless Powder' (1896); Bernadou, 'Smokeless Powder, Nitrocellulose and Theory of the Cellulose Molecule' (1901); Daniel, 'Dictionnaire des matières explosivs' (Paris 1902); Worden, 'Nitrocellulose Industry' (New York 1911); Weaver, 'Military Explosives' (New York 1917); Marshall, 'Explosives' (Philadelphia 1917); Guia, 'Chimica delle sostanze esplosive' (Milan 1919).

CHARLES E. MUNROE.

SMOKY HILL RIVER, or **SMOKY HILL FORK,** the source is in eastern Colorado and it flows into the State of Kansas through Wallace, Logan, Gove, Trego, Ellis, Russell, Ellsworth, McPherson and Saline counties. About 10 miles west of Abilene unites with the Solomon River and forms the Kansas River. It is over 500 miles long and traverses a prairie region noted for its fertility.

SMOKY MOUNTAINS, or **GREAT SMOKY MOUNTAINS,** on the boundary of North Carolina and Tennessee; a part of the Appalachian system, about 50 miles in length and 25 to 50 miles west of Asheville, N. C. The highest peaks are Mount Guyot, 6,636 feet high and Clingman's Peak, 6,660 feet high. This mountain is the scene of one of Mary Noailles Murfree's (q.v.) stories, 'The Prophet of the Great Smoky Mountain.' The region is highly picturesque and nearby towns are favorite winter resorts.

SMOKY QUARTZ, a smoky-yellow to brown and black variety of the mineral quartz. It is often transparent and then yields gems of considerable beauty. Cairngorm (q.v.) is a yellowish variety. Morion is nearly black. The crystalline smoky quartzes include many familiar gem stones, as bloodstone, agate, jasper, carnelion, chalcedony, onyx, etc. Magnificent crystals weighing as much as 250 pounds have been found in Switzerland; very choice crystals, sometimes of large size, occur in Maine, North Carolina, Montana and Colorado.

SMOLENSK, smō-lĕnsk′, Russia, (1) Capital of Smolensk, on the Dnieper, about 250 miles west southwest of Moscow. It occupies steep slopes, rising from the river's edge and is surrounded on the left bank by a wall; on the right bank by earthworks. A large open square occupies the centre of the town. There is a cathedral of the 17th. and 18th centuries, on the site of an earlier structure that was blown up in the Polish siege of 1611; also an episcopal palace, seminary, gymnasium, schools, three public libraries, a museum containing valuable antiquities, theatre and several philosophical and scientific societies. It has manufactories of linen, leather, hats, carpets and soap. Trade is chiefly in corn and hemp. Smolensk was an important town in the 9th century; a strong fortress in the 14th century and in 1812 was taken from the Russians by Napoleon and destroyed by fire. Pop. 71,311. (2) The government organized early in the 11th century and a part of Lithuania in the 15th century, has been Russian since 1654 and now contains 21,632 square miles. It is largely covered by forests. The Dnieper River has its headwaters here and there are numerous streams flowing both north and south. Rye and oats are the chief cereals, flax and hemp are grown extensively, also potatoes. The mining of phosphorite is an important industry, and also the manufacture of lumber and paper. Swine are raised. Pop. 2,050,200.

SMOLENSKY, smō-lyĕn′skĭ, or **SMOLENSKIN, Perez,** Russian Hebrew author and nationalist: b. Monastyrshchina, government of Mogilov, Russia, 25 Feb. 1842; d. Meran, Austria, 1 Feb. 1885. He early gained a knowledge of modern Russian and Hebrew literature and eventually abandoned orthodox Judaism in favor of Jewish nationalism. He traveled throughout Europe studying the problems of the Jews and striving to arouse the people of his race to the desirability of their being united politically. He argued the Messianic era to mean the political and moral emancipation of the Jews. In 1868 he established at Vienna a weekly periodical *Ha-Shahar* («Daybreak») in which he expressed his views. He was deeply interested in the colonization of Palestine in 1880 and was bitterly disappointed at the antagonism manifested toward it by the Alliance Israélite Universelle. He was author of much miscellaneous matter and of several novels dealing with Jewish life, of which the most important is ‹'Am 'Olam› (1873), which contains the outline of the Jewish Nationalist movement.

SMOLLETT, Tobias George, English novelist: b. near Dumbarton, Scotland, 1721; d. near Leghorn, Italy, 17 Sept. 1771. He belonged to a family of Scotch lairds seated at Bonhill, near Dumbarton, in the picturesque valley of the Leven. His grandfather, Sir James Smollett (1648–1731) represented Dumbarton in the old Scots parliament and helped frame the act of union with England in 1707. The laird's youngest son, Archibald, weak and improvident, married Barbara Cunningham, a proud and ill-tempered woman with little or no fortune. Of this marriage were born three children, of whom the last, Tobias George, was christened on 19 March 1721. Two years later the boy's father died, leaving wife and children to the charity of the old knight. After the usual schooling at Dumbarton, the future novelist was apprenticed to John Gordon, a physician and apothecary at Glasgow, and was permitted at the same time to attend lectures at the university, where he seems to have learned his Latin and Greek. In his 18th year he wrote a play called ‹The Regicide,› based like Rossetti's ‹King's Tragedy,› upon the murder of the first James of Scotland.

In 1739, Smollett set out for London, tragedy in pocket, to make his fortune by literature. The play was submitted by Lyttelton, the patron of letters, by whom it was perhaps passed on to Garrick. But it never reached the stage, for which it was ill-adapted, notwithstanding the author's loud denunciation of those who thought so. Smollett now entered the navy as a surgeon's mate and took part in the expedition under Admiral Vernon against Carthagena and the sea power of Spain in America. While at Jamaica, he fell in love with a beautiful creole, Nancy Lascelles, daughter and heiress of an English planter, whom he married then or after his return to London. In 1744 he settled in Downing street and began the practice of surgery. From time to time he wrote odes and satires. His ‹Tears of Scotland,› occasioned by the cruelties of the English at the battle of Culloden, awakened popular sympathy for «helpless Caledonia.» In 1748 he suddenly came to his fame with ‹Roderick Random,› a story of adventure on land and sea following in general outline the career of Smollett himself from the day he left Leven-water. With half its literary merits, it would have been read for its daring personalities and fierce exposé of the dreadful condition of the British navy. Its popularity was quite sufficient to float the next year an edition of the unfortunate ‹Regicide.› At the same time appeared Smollett's translation of ‹Gil Blas.› A trip to France furnished material for ‹Peregrine Pickle› (1751), containing attacks so brutal on Lyttelton, Garrick, Akenside and Fielding, that the author modified or cut them away for a second edition.

In 1750 Smollett obtained the degree of M.D., from the University of Aberdeen and tried to establish himself at Bath. Failing in this last attempt to gain patients, he returned to London and took an old Elizabethan mansion at Chelsea. Here, during the next 10 years he performed, single-handed or by the aid of assistants, an enormous amount of work. The mills never stopped grinding. The ‹Adventures of Ferdinand Count Fathom› (1753) was succeeded by a translation of ‹Don Quixote› (1755) and a ‹Compendium of Voyages› (1756) in seven volumes. A play called the ‹Reprisal or the Tars of Old England› Garrick brought out for him at Drury Lane early in 1757. For a complete ‹History of England› in five volumes (1757–58) he required only 14 months. Revised, enlarged and issued in sixpenny parts, Smollett's history threatened to drive Hume out of the market. Under Smollett's supervision appeared also 'The Present State of All Nations' (1764) in eight volumes and a translation of the entire works of Voltaire. On the founding of the *Critical Review* in 1756, he assumed the editorship. For this monthly he wrote many slashing articles, one of which led to a short imprisonment for defamation of character. He also edited *The British Magazine,* where first appeared as a serial his 'Adventures of Sir Launcelot Greaves' (1762). This manner of publication was an innovation. Smollett's work as editor closed with the short-lived *Briton* (1762), an organ of the Tory party.

Under the pressure of work and grief for the loss of a daughter, Smollett's health broke down. The years 1762–65 were passed with his wife on the Continent, mainly in southern France and Italy. On his return he published a book of 'Travels' (1766), which, despite Sterne's ridicule of it in the 'Sentimental Journey,' displays much common sense. The 'Travels' out of the way, Smollett visited Edinburgh, where his mother was still living, and then went to Glasgow, and the romantic scenes of his childhood. A brief sojourn at Bath for Christmas (1766) and Smollett was back in London at his desk, writing 'The History and Adventures of an Atom' (1769), a savage satire on English politics since 1754. Completely broken in health after this effort, he hastened to Italy, where he settled in a villa near Leghorn. There he wrote his last novel, 'The Expedition of Humphry Clinker' (1771), based upon his recent tour of England and Scotland and planned, it would seem, while at Bath. He saw it in print but never lived to know of its great reception. He died 17 Sept. 1771 and was buried in the English cemetery at Pisa. Two years after his death appeared his characteristic 'Ode to Independence.' His wife, to whom he was fondly attached, remained at Leghorn, where she died in some distress about 1785.

Smollett was a man of rugged honesty. His irritable temperament, about which so much has been written, showed itself in his books rather than in his intercourse with friends. Visitors at Chelsea were surprised at his «polished and agreeable manners and the great urbanity of his conversation.» His cynicism had the saving grace of humor. When he began his 'History of England,' he was a Whig; but he turned Tory during the process of composition, as the Whig ministers, on close examination, proved to be «a set of sordid knaves.» His histories, compendiums and translations, though good narrative, have no further value. As a novelist, he seems, on first sight, to have added nothing to the art of fiction. Instead of beginning with Richardson and Fielding, he went back, as he said himself, to the loose narrative of Le Sage, which admitted of digressions and episodes, without number. For a consideration, he incorporated into 'Peregrine Pickle' the memoirs of a notorious lady of quality. He held too closely, it is said further, for the highest art, to his own experiences. His best known novels are not much more than autobiographies. All this may be granted. But there is the other side. In his early years, he cultivated verse-satire. Had he come a generation or two earlier, he would have been of the company of Pope and Dryden. Coming after Richardson, he was the founder of the satirical novel. His work has immense scope, for it includes men, manners, art and politics at home and abroad. Of his successors, only Disraeli may be compared with him. He wrote our first novel of the sea and is thus a forerunner of Cooper. In 'Count Fathom' may be discovered the beginnings of the Gothic romance afterward practised by Horace Walpole and Mrs. Radcliffe. And 'Humphry Clinker,' «the most laughable story,» said Thackeray, «that has ever been written since the goodly art of novel-writing began,» brought into fiction that spirit of fun which later times have associated with Dickens. See HUMPHRY CLINKER.

Bibliography.— Among good recent editions of Smollett's works may be cited Saintsbury's (12 vols., London 1895), and Henley's (12 vols., London 1899–1901), both of which have introductory essays. The 'Works' with a memoir by the author's friend, Dr. John Moore (8 vols., London 1797) was reissued under the editorship of J. P. Brown in 1872–73. The most interesting of recent biographies is the 'Life' by D. Hannay in the 'Great Writers Series' (London 1887). Scott has a notable essay prefixed to Smollett's novels in the 'Novelists' Library' (London 1821), and Thackeray included him among the 'English Humorists.' The 'Cambridge History of English Literature' (New York 1913) contains an article by Harold Child, 'Fielding and Smollett' (Vol. X) with a fine bibliography.

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SMOOT, Reed, American legislator and Mormon leader: b. Salt Lake City, 10 Jan. 1862. He was educated at Deseret University, Salt Lake City, and at the Brigham Young Academy, Provo. He entered business and became prominent in various industrial enterprises in Salt Lake City and Provo. In 1895 he was appointed one of the presidency of the Utah Stake of the Church of Jesus Christ of the Latter Day Saints, and in 1900 an apostle of that Church. In 1903 he was elected to the United States Senate, but his right to a seat there was contested on the ground that as a high official of the Mormon Church he officially sanctioned polygamy in violation of the laws of the State of Utah, and an oath taken by the members of the Mormon hierarchy said to be inconsistent with loyalty to the national government and Constitution. The Senate by vote decided that he was entitled to take his seat. Since then he has been continuously re-elected. His term in the 65th Congress expires in 1921.

SMUGGLING, the practice of violating the revenue laws of a country by importing or exporting goods upon which duty is payable, with intent to avoid payment of that duty. It is a general custom in all countries to lay a duty on certain imported goods, while in some rare cases a duty is imposed on certain articles exported, as, for instance, some years ago an export duty of two shillings per ton was levied on coal from Great Britain. The phase of smuggling most frequently met with is the secret carrying through the customs of dutiable articles by passengers on ships and trains. Many ingenious methods have been employed to evade the vigilance of revenue officers, frequently with success. Trunks and bags fitted with false bottoms and sides are the common tricks adopted, as well as skilful concealment of contraband on the person. Smuggling is actively carried on over boundaries where the frontier-lines of different countries meet. In such case it is more difficult to detect or prevent illicit importation. Besides introducing taxable goods without payment, smuggling includes the importation of articles that are prohibited from being brought into the country or district. Revenue-cutters are empowered to stop and search any vessel within four leagues of the coast of the United States, while on land any vehicle may be searched, if necessary by force, by authorized officials. Contraband goods thus seized are liable to forfeiture, while a penalty of treble the value of the stock may be imposed. Passengers arriving in the United States are required to make oath as to dutiable articles in their possession. The penalty for defrauding the customs knowingly or wilfully ranges from a fine not exceeding $5,000 or two years' imprisonment. At the discretion of the court, both penalties may be imposed. The forfeited goods are sold, and the proceeds distributed between the government, the informer (if there is one in the case) and the officer who detected the offense. Where the owner of seized goods can establish innocence of intent to defraud, the property may be returned on payment of the duty. Smuggling is especially rife in countries where high or «protective» tariffs prevail. Under the free trade system in the British Isles smuggling is practically confined to spirits, tobacco and scent. Clothes, books, diamonds, lace, etc., are all admitted free of duty.

SMUTS, General Rt. Hon. Jan Christiaan, South African statesman and soldier: b. 1870. He was educated for the law at Victoria College, Stellenbosch; and Cambridge University, England; practised at Cape Town and Johannesburg and was appointed state attorney of the South African republic in 1898. When the Boer War broke out in 1899 he had already a great reputation among the South African Dutch, which was enhanced by his conspicuous services to their cause during the war. On the conclusion of peace in 1902 General Smuts was established with General Botha as one of the two recognized leaders of the Transvaal Dutch. The two men have worked together ever since, loyally accepting the Peace of Vereeniging and carrying on the administration of the Union of South Africa. In the European War, General Smuts commanded the columns of Union troops invading German South-West Africa from the South, and in 1916 he took command of the British forces operating in German East Africa. He organized the campaign which broke the German power in Africa and reduced the German commander von Lettow Vorbeck to the condition of a fugitive, though avoiding capture to the end of the war. General Smuts afterward represented South Africa in the Imperial War Cabinet in London during 1917–18 and, with General Botha, was one of the South African delegates at the Peace Conference in Paris.

SMUTS. See FUNGI; DUST-BRAND.

SMYRNA, smĕr'na (Turkish, IZMIR), Asia Minor, an ancient city and the most important seaport of Asia Minor, on the west coast of Anatolia, at the head of the Gulf of Smyrna (a sheltered inlet of the Ægean Sea extending inward for about 45 miles). A broad quay and artificial harbor, the former traversed by a tramway, borders the sea-front. The city is divided into four quarters — Frank, Turk, Greek and Armenian. The public buildings include the palace of the governor, a large barrack, a number of mosques and several Greek, Armenian, Roman Catholic, and Protestant places of worship, the British consular chapel, an American and two English churches. There is a British seamen's hospital here, for which a new building was erected in 1897. New waterworks were completed in 1898. Smyrna has been for centuries the most important place of trade in the Levant. This trade is carried on partly by shipping, partly by caravans from the interior, and is now supplemented by railways. The chief imports are cotton and woolen manufactured goods; colonial goods, mostly coffee and sugar; iron, coal, hardware goods, leather, timber, glass-ware, butter and margarine, drugs, jute bags, petroleum, etc. The principal exports are raisins, figs, valonia, cereals, tobacco, gum-arabic, opium, carpets, cotton, wool, liquorice, olive-oil. Smyrna has been frequently injured by earthquakes and has also suffered severely from fire. The climate is variable, and fever (usually of a mild type) is prevalent. There are conflicting accounts of the origin of this city; the most probable is that which represents it as an Æolian colony from Cyme. About 688 B.C. it fell into the hands of the Ionians of Colophon. This earliest city, called by the Greeks Old Smyrna, was situated on the banks of the Meles, on the northeast side of the Hermæan Gulf (now the Gulf of Smyrna). It laid claim to the honor of being the birthplace of Homer, and its coins bore his image. This old city was abandoned and was succeeded by a new town on the southeast side of the gulf (the present site), which was said to have been built by Antigonus, and enlarged and embellished by Lysimachus, both generals of Alexander the Great. It was laid out with great magnificence, and adorned with several splendid buildings, among which was the Homereum, where the poet was honored as a god. It soon became one of the greatest and most prosperous cities in the world. It was especially favored by the Romans on account of the aid it lent them in the Syrian and Mithridatic wars. In the civil wars it was taken and partly destroyed by Dolabella, but it soon recovered. It is one of the two among the seven churches in Asia which Saint John addresses without rebuke, and it was the scene of the labors and martyrdom of Polycarp. In the 13th century only the ruins of its former splendor were left; but after the Turks became masters of the country it began to revive until it became the most flourishing city of Asia Minor. As a result of the European War, Smyrna was handed over to Greece as the mandatory by the Peace Conference. Greece took charge of the city in May 1919. Pop. about 250,000, fully half being Greeks.

SMYRNA CAMP GROUND, Engagement at, in the Civil War. On the night of 2 July 1864, Gen. J. E. Johnston abandoned

Marietta for a new position 10 miles south, covering the railroad and his pontoon-bridges, with an advanced position at Smyrna Camp Ground, six miles below Marietta. Sherman pushed forward from Marietta on the morning of the 3d, hoping to catch Johnston before he could get his army across the Chattahoochee, and was much surprised when the head of Thomas' column ran up against strong works at Smyrna Camp Ground, covering the wagon-road and railroad. The army was deployed, and there was heavy skirmishing. On the 4th General Dodge, commanding the 16th corps, moved out on the Ruff Station road and developed a Confederate position of two intrenched lines, strongly held. Dodge intrenched. At 4 P.M. a charge was made by three regiments of Veatch's division, under Col. E. F. Noyes, and three regiments of Sweeny's division, resulting in the capture of Johnston's first line of works and over 100 prisoners, with a Union loss of 140 killed and wounded, Noyes losing a leg. During the night Johnston abandoned his advanced position and drew back all his army and trains to the intrenched line covering the railroad bridge. Sherman closed up against him and was met by a heavy and severe fire, then threw forward both flanks, and by morning of the 6th held possession of the river above for 18 miles, as far as Roswell, and 10 below to the mouth of the Sweet Water. On the 9th Sherman crossed a part of his army over the Chattahoochee, near Roswell, and that night Johnston abandoned his position, crossed to the south side of the Chattahoochee, burned the railroad bridge and his pontoon and trestle bridges and took position in the outer defenses of Atlanta. Consult 'Official Records' (Vol. XXXVIII).

SMYTH, Charles Henry, Jr., American geologist: b. Oswego, N. Y., 21 March 1866. He was graduated at Columbia University in 1888, took his Ph.D. there in 1890, and later studied at the University of Heidelberg. He was professor of geology and mineralogy at Hamilton College in 1891–1905, and since 1905 has occupied the chair of geology at Princeton University. He is author of many scientific papers.

SMYTH, smīth or smĭth, **Charles Piazzi,** English astronomer: b. Naples, 3 Jan. 1819; d. 21 Feb. 1900. He was employed at the observatory at the Cape of Good Hope (1835–45); was astronomer royal for Scotland (1845–88); and retired on a pension in 1888. He made a most thorough examination of the great Egyptian pyramid and was led to the conclusion that the structure was raised under direct inspiration of God, and that therein were deposited revelations of the great truths of physical nature. He wrote 'Our Inheritance in the Great Pyramid' (1864); 'Life and Work at the Great Pyramid' (1867); 'Antiquity of Intellectual Man' (1868), etc.

SMYTH, Egbert Coffin, American Congregational clergyman and author: b. Brunswick, Me., 24 Aug. 1829: d. Andover, Mass., 12 April 1904. He was graduated from Bowdoin College in 1848, and from Bangor Theological Seminary in 1853. In 1862–63 he studied in Germany when he was called to Andover as professor of ecclesiastical history, and was for more than 40 years identified with the growth of Congregationalism. From 1886 to 1892, as editor of the *Andover Review* he was involved in a religious controversy with the more orthodox clergymen of the denomination, but was upheld by his colleagues and the progressive members of the church at large. He was the author of 'The Divinity of Jesus Christ' (1893); 'From Lessing to Schleiermacher, or From Rationalism to Faith' (Boston Lectures 1870), and 'Influence of Jonathan Edwards on the Spiritual Life of New England' (1901), etc.

SMYTH, Herbert Weir, American classical scholar and educator: b. Wilmington, Del., 8 Aug. 1857. He was graduated at Swarthmore College in 1876, later studied at Harvard University and took his Ph.D. at the University of Göttingen in 1884. He was professor of Greek at Bryn Mawr in 1888–1901; was professor of Greek at Harvard in 1901–02, and has since been Eliot professor of Greek literature there. He was professor in the American School of Classical Studies at Athens in 1899–1900. He edited 'Greek Series for Colleges and Schools' (20 vols.). Author of 'The Sounds and Inflections of Greek Dialect: Ionic' (1894); 'Greek Grammar' (1914).

SMYTH, John Paterson, Canadian Anglican clergyman: b. Ireland, about 1856. He was graduated at Trinity College, Dublin, and was ordained a priest in the Church of England in 1881. He was professor of pastoral theology at Trinity College, Dublin, in 1902–07; became canon of Dublin Cathedral in 1907; and later went to Canada as rector of Saint George's Church at Montreal. He was appointed canon of Christ Church Cathedral, Montreal, in 1910, and archdeacon in 1914. Author of 'Israel's Prophets and Kings' (1906); 'The Prayer Book' (1908); 'The Bible in the Making' (1914); 'God and the War' (1915); 'The Men Who Died in Battle' (1915), etc.

SMYTH, Samuel Phillips Newman, American Congregational clergyman and author, brother of E. C. Smyth (q.v.): b. Brunswick, Me., 25 June 1843. He was graduated from Bowdoin College in 1863, and at Andover Theological Seminary in 1867. He was called to the First Congregational Church of Bangor, Me., and in 1882 to the First Congregational Church of New Haven, Conn. He is the author of 'Old Faiths in New Lights'; 'The Orthodox Theology of To-day'; 'The Morality of the Old Testament'; 'Christian Ethics'; 'Through Science to Faith'; and other books.

SMYTHE, Ethel Mary, English composer: b. London, 23 April 1858. She studied at the Leipzig Conservatory and later under Heinrich von Herzogenberg, and received the degree of Doctor of Music at Durham in 1910. Her early compositions included songs, chamber music, a mass in D which gained for her recognition as a composer of great ability, a sonata, and other pieces. Her reputation became firmly established with the production of her first opera, 'Fantasio,' produced at Weimar in 1898. She ranks as one ot the leading composers of her time, and probably the first among women composers. Her second opera 'Der Wald' was produced at Dresden in 1901, at London in 1902, and at the Metropolitan Opera House, New York, in 1903. 'The Wreckers' was produced at Leipzig in 1906, and 'The Boatswain's Mate' (1915) was produced in London in 1916.

SNAIL-BORE. See Drill.

SNAILS AND SLUGS, names restricted in their original application to gasteropodous mollusks typifying the families *Helicidæ* and *Limacidæ* respectively, but now used in a much wider sense. The terrestrial and fresh-water snails and slugs represent the order *Pulmonata,* characterized by the presence of a lung-sac for the respiration air formed by a fold of the mantle and opening by a conspicuous pore situated at the mantle border, usually on the left side. They are always asymmetrical, but have the visceral loop of the nervous system straight and the ganglia concentrated in a ring about the œsophagus. All are hermaphroditic, though the structure of the complex genital organs varies greatly. A shell is generally present, though absent or rudimentary in the slugs, and is usually dextral. Except in the brackish water *Amphibolidæ* of New Zealand there is no operculum. Within the mouth is the jaw, usually single and placed just behind the upper lip, but in some forms there are accessory pieces and in others the jaw is absent. Both the jaws and the teeth on the lingual ribbon or odontophore present an astonishing variety of form which is characteristic of genera and species. With these organs the food, usually vegetable, is cut and rasped. Scarcely any of the *Pulmonata* are marine, and very few live in even brackish water, though a large number inhabit fresh water and some the depths of lakes, from which they never come to the surface to breathe air, but take water into the lung, which has, therefore, secondarily assumed the function of a gill. The great number of species are arranged in two sub-orders: the *Basommatophora,* which have non-retractile tentacles with the eyes situated at their bases and male and female organs opening separately, and the *Stylommatophora,* with retractile and often invaginable tentacles, two of which bear the eyes at their tips, and the genital orifices generally united. Each suborder includes numerous families, upon the exact number and arrangement of which authorities are not yet fully agreed.

As examples of the sessile-eyed snails the following may be selected, the generic names employed being in most cases in the less restricted sense. *Melampus lineatus* represents the family *Auriculidæ,* and is one of the few marine species, inhabiting the salt marshes along the coast in great numbers. The shell is solid and sub-oval, with a polished surface of a handsome brown color marked with reddish bands. The *Limnæidæ* are the common pond-snails, which have a very delicate fragile shell and the orifice of the lung protected by a special lobe. The species are very numerous and abound everywhere in sluggish fresh waters. *Planorbis* has the shell rolled in a flat spiral and thicker than usual in the family. A number of species are common in the sluggish rivers and streams of the United States, where they may be found attached to stones along with masses of their eggs. *Limnæa* is the type genus and is known by its rather slender, dextrally spiral, delicate shell with a large aperture. *L. stagnalis* is abundant in ponds, and other species are particularly well represented in the northern States and Canada. Their eggs may be found imbedded in little packets of transparent jelly attached to aquatic plants throughout the summer. During seasons of drought these and other water snails burrow into the mud or close the aperture of the shell by a membrane formed of secreted mucus. They are strictly vegetarian and make useful and interesting inmates of aquaria. *Physa heterostropha* is equally common and has similar habits, but the very delicate shell is sinistral. *Ancylus* includes the fresh-water limpets, our species being very small, with flattened conical shells, which are found attached limpet-like to stones and plants in ponds. This group includes no slugs.

The stalked-eyed snails are more numerous and important. *Glandina truncata* of fresh-water swamps of the southern States belongs to the family *Testacellidæ,* which are remarkable because of their carnivorous habits and the absence of a jaw. This species has a well-developed shell, but the related genus *Testacella* of Europe is a slug, bearing the small disc-like shell at the posterior end of the body. It attacks and devours earthworms and slugs, but also eats decaying animal matter. The true slugs belong to the family *Limacidæ* in which the shell, if present, is usually buried in the mantle or else is a plate covering only a small portion of the animal. The visceral hump of the snails is absent or little developed in the slugs. The body is generally oval or oblong, elongated, from one to three inches in length. The creeping disc, or sole of the foot, extends the whole length of the animal, but, like snails, slugs frequently raise their heads and move their tentacles in search of objects above them. They often climb trees, and can lower themselves to the ground by the accumulation of mucus at the extremity of the tail hardening into a thread, and as they crawl they leave a slimy track. They oviposit in moist places in spring and summer, often at roots of grass; the eggs are laid in strings, each in a separate gelatinous envelope. Slugs are found in moist places in the woods, damp cellars, etc., and are especially partial to decaying wood, upon which they in part feed. But their chief food consists of the tender leaves and shoots of plants, and the garden species often inflict considerable damage upon lettuce, celery, etc., but much less in this country than in Europe. They may be checked by sprinkling wood ashes, lime or soot about young and tender plants or in cellars by sprinkling salt about their haunts. They are active at night and conceal themselves by day. During the winter they hibernate. Among the genera are *Arion, Agriolimax, Limax* and its numerous subdivisions. Several of our common garden and cellar species are European importations. *Limax maximus* is very common and four or five inches long, of an ashy gray color with black stripes and spots. It is sometimes eaten in England. *L. campestris* is very common in woods and meadows. It is much smaller and uniform pale gray or brown. *Arion fuscus,* a European species, has been introduced into this country in the neighborhood of Boston. The shell is concealed and very imperfect and there is a large triangular mucous pore near the posterior end. The eggs are said to be phosphorescent. *Philomycus carolinensis* is a large slug found under logs and bark in woods and which is often placed in a distinct family. There is no trace of a shell and the mantle covers the entire back.

The *Helicidæ* or family of true snails is an immense one, the typical genus alone in its unrestricted sense embracing about 6,500 species. They abound in moist places and have very similar habits the world over. They feed chiefly on vegetable substances, though they are very indiscriminate in their appetite and even devour the dead of their own kind. The mischief which they do to garden crops is too well known; and gardeners lay down cabbage leaves and the like to attract them, in order that they may be destroyed. Snails delight in warm, moist weather; in dry weather, their chief time of activity is during the night, and they hide themselves by day; but after rain they come forth at any hour in quest of food. At the approach of winter or in very dry weather they close the mouth of the shell with a membrane (epipihragm), formed by the drying of the mucous substance which they secrete, and become inactive and torpid. Snails retreat into crevices for the winter, or into holes which they make in the earth, and which are roofed over with earth, dead leaves, etc., agglutinated by secreted mucus. The eggs are deposited in moist earth, the snails often burrowing beneath the surface for this purpose and they have no jelly but only a slightly adhesive covering. Among the most plentiful of our native species are *Helix albolabris* and *H. alternata* and the minute *Zonites milium* (not closely related) found everywhere in damp woods. Several of the large European species have been introduced. The great vine snail, or edible snail (*Helix pomatia*), a European species, was considered by the ancient Romans one of their table luxuries. In some countries, as Switzerland and parts of France, they still form a considerable article of commerce. Together with *H. aspersa*, they are fed by thousands in places called «escargatoires,» which are made on purpose for them. Preserved snails are imported into the United States for table use, and the demand has increased sufficiently to induce a few persons to inaugurate the business of raising them, particularly in California. On account of its large size and gregarious habits the European *H. pomatia* is best suited to this purpose. Another family of water snails (*Paludinidæ*) belongs to a quite different division of the *Gasteropoda*, the order *Prosobranchiata*. In these forms the usually single ctenidium is placed anterior to the heart, and the visceral nervous loop is twisted into a figure 8. The order is a very extensive one, most of the members of which are marine. With the *Valvatæ*, *Ampullariæ*, which are related fresh-water forms often placed in distinct families, the species of *Paludina* and *Vivipara* have the left ctenidium only and a single kidney and heart auricle. The shell is usually stout, more or less pyriform and has a well-developed operculum. The single pair of non-retractile tentacles bear the eyes upon lobes near their bases and the edge of the mantle forms a pair of short tubes by which water is directed over the gill. The sexes are always separate and the young are produced alive. Common species are *P. integra*, *P. intertexta* and *P. vivipara*, which live on the mud at the bottom of ponds and sluggish streams. They are, at least in part, carnivorous. Other important fresh-water families are the *Pleuroceridæ* and *Melaniidæ*, including chiefly oviparous forms which have the thick shell variously ornamented with spines and tubercles. Of the numerous forms found in the mountain streams and eastern tributaries of the Mississippi and elsewhere the large and variable *Io spinosa* is an example.

Bibliography.— Pilsby and Tryon, 'Manual of Conchology' (Philadelphia 1878–1904); Binney and Gould, 'Terrestrial Air-breathing Mollusks of the United States' (Boston 1851 to 1859); Binney, Bland, Prime and Tryon, 'Land and Fresh-water Shells of North America' (Smithsonian Institution, Washington, 1865–73); Cooke, 'Cambridge Natural History' (Vol. III, London 1895); and for an excellent popular account Ingersoll, 'Wild Life in Orchard and Field' (New York 1903) See GASTEROPODA.

SNAKE, or LEWIS (the SHOSHONE of the Indians), a river which has its rise in the mountains of western Wyoming, in two streams, called the North and South Forks. Entering Idaho the river flows southwest, then northwest to the Oregon State boundary, then north, forming the boundary for 100 miles, between Oregon and Idaho to Lewiston, and the boundary between Washington and Idaho for 30 miles. It then turns westward, crosses the southeastern part of Washington and enters Columbia River near lat. 46° 12′ N. and long. 119° W. Its length is estimated to be about 1,000 miles. Where the North and South Forks unite the elevation is 4,800 feet and at the mouth, where it enters the Columbia, it is 340 feet. Its course is through a mountainous country, here and there entering plains, winding around seemingly extinct volcanoes, passing through fertile lands in Washington. It is noted for its wonderful cañons, and in places for the springs that pour in great abundance from its northern wall. A fine exhibition of cataracts is furnished at the Thousand Springs near Hagerman, Idaho, between Salmon Falls and the point where the Salmon Falls River enters from the south. The springs in countless numbers issue from rocks far up the faces of nearly vertical precipices. The water does not make the descent in a single leap, but in a series of cascades. It is lashed into foam by contact with the rocks and the beauty of the scene defies description. The Shoshone Falls (q.v.) are among the wonders of the world. Many of the cañons of the river are from 1,000 to 3,000 feet in depth and the waters flow rapidly over irregular beds forming long rapids and magnificent cascades. A number of side alcoves, or short, «blind» cañons, leading off the main cañons, owe their existence to great springs. These side cañons receive no surface streams and there is no other explanation of their formation. The springs undermine the rock by removing the soft material on which it rests. The rock falls into the spring and gradually sinks into its soft bed and thus the cañons are formed. Often the undermining is on so large a scale that the falling rock becomes a landslide. The water in the streams which the springs form is intensely blue and very clear. Some of them are well stocked with trout, although on the edge of a desert.

SNAKE-BIRD. See DARTER.

SNAKE DANCE, a dance of religious character performed by the Moqui Indians, living in Arizona, United States of America. The dance is known to have been performed by this tribe of Indians, in the same manner and in the same place, ever since the middle of the 16th century, when the Spanish explorers entered this part of America. The rite is particularly revolting in some of its details, which include the bearing of live serpents in the hands and the mouths of the dancers. As many as 100 snakes are used in a dance and each of these is borne by the dancers while dancing, either in his hands or mouth, is then deposited upon the ground, where it is sprinkled with the sacred cornmeal by the Indian squaws, is picked up, held by old men, then by little boys, infants even, and is then deposited in a sacred tent lined with buffalo skin, inside of which a sacred tree is growing. Toward the end of the dance the snakes are taken out of the tent and carried in armfuls by the Indian men, are placed on the ground within a circle of sacred meal in front of a sacred rock. Here to the accompaniment of prayers and chants the serpents are sprinkled with the sacred cornmeal until the whole writhing, wriggling mass is completely covered by the meal. The dance concludes by the Indian men grasping each as many snakes as he can hold and dashing down a steep incline at top speed. At its foot the snakes are liberated, scattered in every direction. The ceremony is described as most revolting. For a full account consult Bourke, J. G., ‹Snake-Dance of the Moquis› (1884); Hough, W., ‹The Moki Snake Dance› (Chicago 1898).

SNAKE-DOCTOR, a dragon-fly (q.v.).

SNAKE-EEL, an eel of the large family *Ophichthidæ,* scaleless, and with the extremity of the tail free, that is, not surrounded by a fin. These eels are found abundantly in tropical seas about rocks and coral reefs and are often gayly colored like murænas, to which they are allied. Consult Jordan and Evermann, ‹Fishes of North and Middle America› (Washington 1896).

SNAKE-GOURD. See Gourd; Melon.

SNAKE-MELON. See Melon.

SNAKEROOT, the popular name of numerous American plants of different species and genera, most of which are, or formerly were, reputed to be efficacious as remedies for snake-bites. (For two prominent kinds see Aristolochia and Polygala). The black snakeroot (*Cimicipuga racemosa*) is a common woodland herb, four to eight feet high, with long racemes of white flowers. The white snakeroot is a handsome herb (*Eupatorium ageratoides*) and belongs to the asters. It has large, coarsely serrated opposite leaves and is also known as white sanicle. The Seneca snakeroot (*Polygala Senega*) is of the milkwort family and common in the eastern United States. It has a heavy woody rootstock, several stems grow 6 to 12 inches high, alternating lanceolate leaves and perennial white flowers in spickes. The Brazilian snakeroot (*Chiocoeca augustifolio*) is a shrub of the madder family, the roots furnishing an emetic and cathartic assumed to relieve snake-bite. Sampson's snake-root (*Psoralea melilotoides*) is a perennial of the bean family, growing in the southern United States. It is a stimulating tonic. The Canada snakeroot is the wild ginger.

SNAKE-STONE, a porous stone, as a fossil ammonite, or any porous substance, supposed to cure snake bites. The superstition came, it is believed, from Eastern countries. The stones, which are usually small, are supposed, when applied to a snake-bite, to absorb the poison, counteract the poisonous effects, or to charm the wound away. Some of the snake-stones used in India seem to be efficacious. Two small snake-stones (about the size of a pea) brought from that country and said to have cured a cobra bite, were found on examination to be composed of some vegetable substance. Another, which was brought from Ceylon by Sir J. E. Tennent, and which was known to have effected a like cure, was submitted to the examination of Professor Faraday, who fancied it to be a piece of charred bone which had been filled with blood perhaps several times and then carefully charred anew. Owing to their absorbent properties such stones, if applied at once, may be of some avail. The superstition is particularly prevalent among the negroes of the southern States and in some portions of England and Scotland where charms made of small stones perforated and strung like beads are hung on cattle to keep away adders and to cure any snake-bites.

SNAKE-WOOD, any of various woods and plants. One is the small South American tree (*Brosimum aubletii*) which has hard, white sapwood surrounding the valuable heart, which seldom exceeds seven inches in thickness, is reddish and marked with black in such a manner as to suggest hieroglyphics; the spots have suggested such other names as letter-wood and leopard-wood. It is used for walking canes, veneers and cabinet-making. *Strychnos colubrina,* a climbing plant of India, like the *S. nuxvomica,* yields in its bitter roots and wood, a reputed native cure for snake-poison. *Colubrina ferruginosa* (West Indies), so called, perhaps, from its twisted grain, *Plumeria rubra* and *Cecropia peltata,* are also called snake-wood.

SNAKES. See Serpents.

SNAP-DRAGON, cultivated species of the genus *Antirrhinum* (*Scrophulariaceæ*). *A. majus* is the common snap-dragon, a pubescent perennial, native to Europe, with linear lanceolate leaves, chiefly alternate and large showy flowers, having irregular gibbous, two-lipped corollas, the lower, three-lobed lip so swollen at the base as to nearly close the throat of the flower and giving an appearance so like a mouth that it has suggested many descriptive names, such as bulldog's, rabbit's, dog's or toad's mouth; even the Greek name means «nose-like.» They are handsome herbs, one to three feet high and have flowers of many shades and markings and are not only cultivated in old-fashioned hardy gardens, but in greenhouses for winter floral trade. The plant is reputed, in folk-lore, to have the power of destroying charms. The Jamaica snap-dragon (*Ruellia tuberosa*) is of the acanthus-family, bears a pretty blue flower and is cultivated in hot-houses.

SNAPPERS, a rather numerous assemblage of fishes belonging to the genus *Lutjanus* and related genera, usually considered as belonging to the family *Sparidæ* (q.v.), but sometimes erected into a distinct family (*Lutjanidæ*). They have the body more elongated than the typical members of the *Sparidæ,* the teeth little differentiated and never incisor-like, though some are usually enlarged and caniniform and there are always teeth on the vomer. The dorsal fin is continuous, with strong spines and the anal fin has three stout spines. The species of *Lutjanus* inhabit most warm seas and about 20 are found in our southern waters, some of them attaining importance as food fishes. The red snapper (*Lutjanus aya*) is a handsome rose-red fish, the young with a black blotch on the side. It attains a length of 2½ feet and a weight of 25 pounds, and is economically the most important of the group. Throughout the West Indian region and in the southern United States it is a great favorite, and is shipped to northern markets also in considerable numbers. The centre of the fishery is Pensacola, from which smacks visit the snapper banks in various parts of the Gulf of Mexico. The gray or mangrove snapper (*L. griseus*) is another abundant and widely distributed species throughout the same region and sometimes strays northward as far as Cape Cod. It is of a dark green color above and reddish below and is further distinguished from the red snapper by the much lower ventral fin. Being smaller than the latter it is of less commercial importance, but because of its greater abundance in shallow waters is an even greater favorite with amateur anglers. A third species is the mutton fish (*L. analis*). This is a beautiful fish in life, being olive green above, with red fins and pale blue spots and streaks on the head and sides. It equals the red snapper in size and, like the other species, frequents rocky banks and spawns in summer. It is said to be the most important food fish in Havana. All of the snappers are gamy and are caught chiefly on hand lines, but in Jamaica and other West Indian islands in cane fish-pots constructed on the principle of lobster-pots. Consult Jordan and Evermann, 'American Game and Food Fishes' (New York 1902); Jordan, D. S., 'Fishes' (New York 1908).

SNAPPING TURTLE, a large freshwater turtle (*Chelydra serpentina*), widely distributed over the United States. These voracious creatures grow to a considerable size, a weight of 20 pounds being far from uncommon, and are prized as food. Their popular name is derived from their ferocity in captivity, and their habit of biting or snapping at everything that comes in their way. Called also alligator terrapin and alligator tortoise.

SNARE OF LOVE, Order of the. See ORDERS AND DECORATIONS (ROYAL).

SNATCH BLOCK, a single block; that is a block or case carrying a single pulley, in use on ships. It has an opening (notch) in one cheek to receive the bight of a rope. The block is iron-bound, with a swivel hook. The portion of the strap which crosses the opening or snatch in the block is hinged, so as to be laid back when the bight of the rope is to be inserted, as when warping the ship. This saves the trouble of reeving the end of the rope through. Large blocks of this kind are called rouseabout blocks, also viol blocks. Double and triple sheaved blocks are sometimes made with a snatch.

SNAYERS, Peter, Dutch painter: b. Antwerp, 1592; d. Brussels, 1667. His teacher of painting was S. Vranx; he was elected to the Guild of Saint Luke in 1613, and went to Brussels as court painter in 1628. Of his numerous battle pieces, the majority were painted for the Austrian Court, of which works 12 are now in the Imperial Gallery at Vienna. His other canvases represent cavalry skirmishes, small war scenes, hunting scenes, landscapes, painted with life-like expression and action. His works are found in most public galleries and are especially well represented in Dresden and Madrid, 16 being hung in the Prado.

SNEATH, E. Hershey, American educator and author: b. Mountville, Pa., 7 Aug. 1857. He was graduated at Lebanon Valley College in 1881 and received the degrees: A.B., 1881, A.M., 1885 and LL.D., 1903, Lebanon Valley College; B.D., 1884, and Ph.D., 1889, Yale University. From 1889 lecturer and professor of philosophy; since 1912 he has been professor of the philosophy of religion and religious education in Yale University. He organized the 'Modern Philosophers and the Ethical Series,' and is author of 'The Philosophy of Reid' (1892); 'The Ethics of Hobbes' (1898); 'The Mind of Tennyson' (1900); 'Philosophy and Poetry' (1904); 'Wordsworth — Poet of Nature and Poet of Man' (1912). Joint author with Dean Hodges of a manual, 'Moral Training in the School and Home.' Organized and is one of the editors of 'The Golden Rule Series' (6 vols.) and 'The King's Highway Series' (8 vols.); the former representing a graded system of moral instruction for schools, the latter representing a graded system of moral and religious instruction for the home and school.

SNEEHATTEN, snā'hăt-tĕn ("snow-cap"), Norway, the highest point of the Dovrefjeld, situated 80 miles southwest of Trondhjem. It is a snow-capped peak 7,566 feet in altitude.

SNEEZE-WEED, any one of the composite genus *Helenium,* as *H. autumnale,* a tall, rank-growing sunflower-like plant. It has a few long-rayed yellow heads, with protruding discs appearing in autumn, and is occasionally cultivated, although it is very coarse, with square, winged stems and alternate large punctate entire or dentate leaves. These and the flowers are bitter, acrid and pungent, and when dried and powdered cause violent sneezing, having been used in materia medica for this purpose. Sneeze-weed is generally avoided by cattle, but animals unfamiliar with, or developing a taste for it, are often poisoned by it. The name is also sometimes applied to the sneeze-wort (q.v.).

SNEEZE-WOOD, a valuable wood, also called nieshout, yielded by the large South African tree *Pteroxylon utile* of the order *Sapindaceæ,* and brought to market in logs sometimes 80 feet long and four feet in diameter. It is very difficult to work on account of its great hardness, and the dust arising causes much sneezing (whence the name), but it is handsome, with a yellowish grain resembling sandalwood, durable and avoided by white ants and shipworms.

SNEEZE-WORT, a composite herb (*Achillea ptarmica*) with larger and fewer white flowers than has the common yarrow of the same genus and finely serrate linear leaves, which, when dried and pulverized, are said to provoke sneezing. It is a European plant introduced into America.

SNEEZING. See NOSE AND THROAT, DISEASE OF.

SNELL, Henry Bayley, American artist: b. Richmond, England, 29 Sept. 1858. He studied at the Art Students' League, New York, and specializes in the painting of landscapes. He was awarded the gold medal of the Philadelphia Art Club in 1896 and was elected to the National Academy in 1906. Among his landscapes are 'Citadel at Quebec' (Albright Gallery, Buffalo); 'Nightfall' (Art Association, Indianapolis); 'Lake Como' (Metropolitan Museum, New York); 'Low Tide' (1907); 'The Harbor Light' (1913).

SNELLING, Fort, a small town and military post on the right bank of the Mississippi River, in Hennepin County, Minn. The fort was established in 1819 and is situated just above the mouth of the Minnesota River and about six miles southwest of Saint Paul. It is on the Chicago, Milwaukee and Saint Paul Railroad. Fort Snelling is shown in Humphrey and Abbott's war map of the 'Basin of the Mississippi,' etc., prepared for the War Department of the United States government in 1861.

SNICKER'S FERRY AND BERRY'S FERRY, Engagements at, American Civil War. General Early withdrew from the front of Washington on the night of 12 July 1864, recrossed the Potomac at White's Ford on the morning of the 14th, rested that day and the next at Leesburg, and on the 16th marched through Snicker's Gap. On the morning of the 17th he crossed the Shenandoah at Snicker's Ferry and took position near Berryville, Breckinridge's command of two divisions covering Snicker's Ferry and the river above and below, and Rodes' and Ramseur's divisions, the roads to Harper's Ferry. On the 16th General Crook, commanding three small divisions of Union infantry and one of cavalry, had run into Early's rear, near Purcellville, capturing 50 prisoners and 80 wagons. Under orders of General Wright, commanding the forces pursuing Early, Crook, on the 17th, sent Duffié's division of cavalry and Mulligan's brigade of infantry to Snicker's Gap, which was seized, but upon approaching the Ferry Early's well-posted artillery checked the column. On the 18th the remainder of Crook's command was pushed through the Gap and Duffié's cavalry was ordered through Ashby's Gap to attack Early's train in flank, it being the impression that Early was retreating up the valley. About 2 P.M. Crook directed Colonel Thoburn, with the two brigades of his own division and one of Duval's, to cross the Shenandoah at a ford a mile or more below Snicker's and, moving up, uncover it. Here a picket of about 100 men was encountered, which opened fire, but Thoburn's leading brigade dashed across the stream and captured 15 prisoners, from whom it was learned that Early, with two divisions, was very near, and Thoburn was ordered not to advance, but to await the arrival of the Sixth corps. He had crossed his whole command and formed a defensive line; beyond his right was a force of 1,000 dismounted cavalry of various regiments, under Lieutenant-Colonel Young, Fourth Pennsylvania Cavalry. It was less than an hour after making these dispositions that Breckinridge, with the divisions of Gordon and Echols, advanced against his left and centre, and Rodes' division fell upon his right. The dismounted cavalry broke under Rodes' fire and, despite Young's effort to rally it, retreated across the river, carrying some of the infantry with it. Rodes pressed on, Thoburn changed front to meet him, but his right was forced back and driven across the stream. The left of the line repulsed two or three determined attacks and, under orders, withdrew across the river. The dead and wounded were left on the field. The Union loss was 65 killed, 301 wounded and 56 missing. The Confederate loss was about 300. Duffié, who marched for Ashby's Gap with 2,000 men and artillery, camped near Upperville on the night of the 18th, and next morning drove some cavalry through Ashby's Gap, and with one brigade crossed the Shenandoah at Berry's Ferry, where he was met by Imboden's and McCausland's brigades of cavalry, with two guns, and driven back. Artillery-fire was continued by both sides, and at 5 P.M. another effort was made to cross the river. One regiment charged across and up to the Confederate guns, but was quickly driven back with great loss. At night Duffié fell back to Ashby's Gap. His loss was 56 killed and wounded and 68 missing. The Confederate loss was not over 50. Wright remained at Snicker's Gap on the 19th, and that night Early, hearing that General Averell was moving from Martinsburg to Winchester, thus threatening his rear, retreated toward Strasburg. Wright advanced to Berryville on the 20th. Consult 'Official Records' (Vol. XXXVII); Pond, 'The Shenandoah Valley in 1864'; Early, 'The Last Year of the War for Independence.'

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SNIDER RIFLE, The. See SMALL ARMS.

SNIPE, certain limicoline birds of the family *Scolopacidæ*. As explained in the article Sandpiper (q.v.) the names snipe and sandpiper are, to a large extent, used interchangeably, many of the species, more properly designated as sandpipers, having also one or more local names of which snipe forms a part. Besides the woodcock (q.v.), which is closely related, four species properly known as snipes occur in North America. All of these, together with numerous species inhabiting other parts of the world, have the bill very long, much exceeding the head, grooved for its entire length, somewhat flexible, flattened and expanded at the end and there richly provided with nerves and sense-organs. Because of these peculiarities these birds are enabled to employ the bill at once as a delicate, sensitive probe for exploring the mud deeply, and as a forceps for extracting worms and similar articles of diet which they there detect. The slit of the mouth is almost totally confined to the bill; the nostrils are rather large and placed very far back, almost above the eyes and not directly in front of them as in most birds. The typical snipes belong to the genus *Gallinago*. Besides exhibiting the characters just enumerated in a high degree of development, this genus has the toes entirely without webbing, the tarsi short, less than the middle toe, the body full and plump, the wings short and rounded, the tail feathers numerous, variable in the different species and cross-barred. There is no noticeable difference in the plumage with season or sex. About 20 species are known, the majority from Eurasia and the others scattered. The only properly North American species is the well-known and favorite Wilson's snipe (*Gallinago delicata*), also known as the snipe, jack-snipe, American snipe and, through mistaken identity, as the English snipe. Its length varies from 10 to 11½ inches, the smaller birds being females, and its color a mottled mixture of various browns, black and white, giving a dark effect above, white below. There are 16 tail quills. Like most species of the family, it breeds northward, from the extreme northern United States to beyond the Arctic Circle. Within the United States it is widely distributed, during the spring migrating from March to May, and more abundantly in the fall from September to November. It frequents open marshes, both fresh and salt, and is consequently chiefly an inland bird, and is plentiful in the central West. In its southward journey it reaches the West Indies and South America, but seems less sensitive to cold than many of its relatives; and individuals sometimes haunt the vicinity of open springs during the prevalence of severe frosts both in the late fall and early spring. Unlike the bay birds the snipe is mostly solitary and never forms large flocks. Night is its chief season of activity, when it flies and migrates and to a great extent feeds. The soft ground in its haunts is probed in all directions for worms, insects, larvæ and similar creatures which, with snails and slugs, are consumed in great quantities. When flushed it utters a loud, rather harsh note and flies rapidly and very irregularly for 20 or 30 yards before setting a direct course. During the mating and nesting season these birds are much about by day and are said to perform remarkable aerial evolutions, often dropping swiftly from a height with a peculiar drumming sound caused by the air rushing through the wings. The nest is a mere depression in the ground lined by a few grasses or leaves, usually in the shelter of a tussock or bush in a bog. The eggs are four and of the pyriform shape usual in the family and grayish-olive tinged with brown and blotched with browns.

The snipe is justly a favorite game-bird and presents qualities which fully test the skill of the sportsman. Its habits and haunts are so easily affected by weather and other conditions that an intimate knowledge of its peculiarities are necessary first to find and then to approach the snipe. On windy, stormy days these birds are extremely wild and their senses are so keen that an unskilled gunner will see only their jerky flight in the distance. On such occasions leave the dog at home and approach the birds from the windward side with a strong-shooting gun. As they always rise toward the wind some good shots may be afforded before the birds get well started. On warm, murky days they lie close and a well-trained setter or spaniel is necessary to flush them, especially if they be scarce. It is, of course, necessary to work against the wind, but when the dog marks, the gunner will do well to work to windward in order to get a quartering shot when the bird rises. The erratic flight of this bird in starting is very disconcerting to a novice and the best plan is to wait until it has steadied before shooting. As a table bird the snipe stands on a level with any.

Of the genus *Macrorhamphus*, in which the toes are slightly webbed, the legs more largely naked than in *Gallinago*, the wings longer and more pointed, and the summer and winter plumages different, we have two species, *M. griseus*, the eastern dowitcher, and *M. scolopaceus*, the western or long-billed dowitcher. The former is known in the summer plumage as the red-breasted, the latter as the red-bellied snipe, which, with the differences in the bill and the generic characters, sufficiently distinguishes them. Their habits are similar and their breeding habits are essentially those of Wilson's snipe. Within the United States they frequent the sea-coasts, flying in dense but not large flocks and associating with various sandpipers and yellow-legs. Their most distinctive traits are their confiding nature, proficiency as swimmers, swift flight and compact flocking. To the first and last of these is due their destruction in great numbers by bay-bird gunners, with whom they are great favorites.

Among European species of snipes may be mentioned the common or English snipe (*G. gallinago*), scarcely distinguishable from Wilson's snipe, except that it has only 14 tail feathers, and the great or solitary snipe (*G. major*), both of which have appeared as stragglers in North America.

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SNIPE-EEL, a small, slender, scaleless, translucent fish of the deep seas, with jaws prolonged into a slender bill, like a snipe's, the upper mandible somewhat recurved. There are many species, which form the family *Nemichthidæ*, closely related to typical eels, but little is known of their habits.

SNIPE-FISH, a small fish (*Centriscus scolopax*) of the Mediterranean and neighboring waters, whose snout is prolonged into a tube suggesting a snipe's bill.

SNOQUALMIE RIVER in King County, Washington, drains a part of the west slope of Cascade Mountains east of Seattle and empties into Puget Sound. The falls, with sheer drop of 300 feet, are 25 miles east of Seattle, and are a resort famous for beauty of scenery. The water is largely utilized for power which furnishes electricity for Tacoma and Seattle. The estimated water power of the stream is 100,000 horse power.

SNORING, the act of breathing with a peculiar rough noise in sleep. This noisy mode of respiration is produced by deep inspirations and expirations through the nose and open mouth, the noise being caused by the vibrations of the soft palate and uvula. The remedy is to tie a bandage under the jaw and over the head, so as to keep the mouth closed. An examination should be made of the nasal passages, which with snorers are usually clogged.

SNORRI STURLASON, snor're stoor'la-son, Icelandic poet and historian: b. Hvamn, 1178; d. 22 Sept. 1241. Tracing his descent from the kings of Norway, he early turned his attention to the history of their doings, and made a collection of sagas entitled the Heimskringla, or the Ring of the World, in which are interspersed songs from prehistoric times and also a number of poems by the skalds of the kings, whose lives are told by Snorri. It contains a record of the Norwegian kings from the earliest time to the death of Magnus Erlingsson (1177), and was first printed in 1697. It has been translated into several languages. Snorri became chief judge of Iceland, but his ambitious and intriguing character led to his assassination.

SNOUT-BEETLE, any weevil of the family *Curculionidæ,* many of which are pests to growing plants or to stored grain, etc. One of the worst in the United States is the imbricated snout-beetle (*Epicœrus imbricatus*) which is widespread and attacks garden vegetables and fruits of all sorts, sucking their juices.

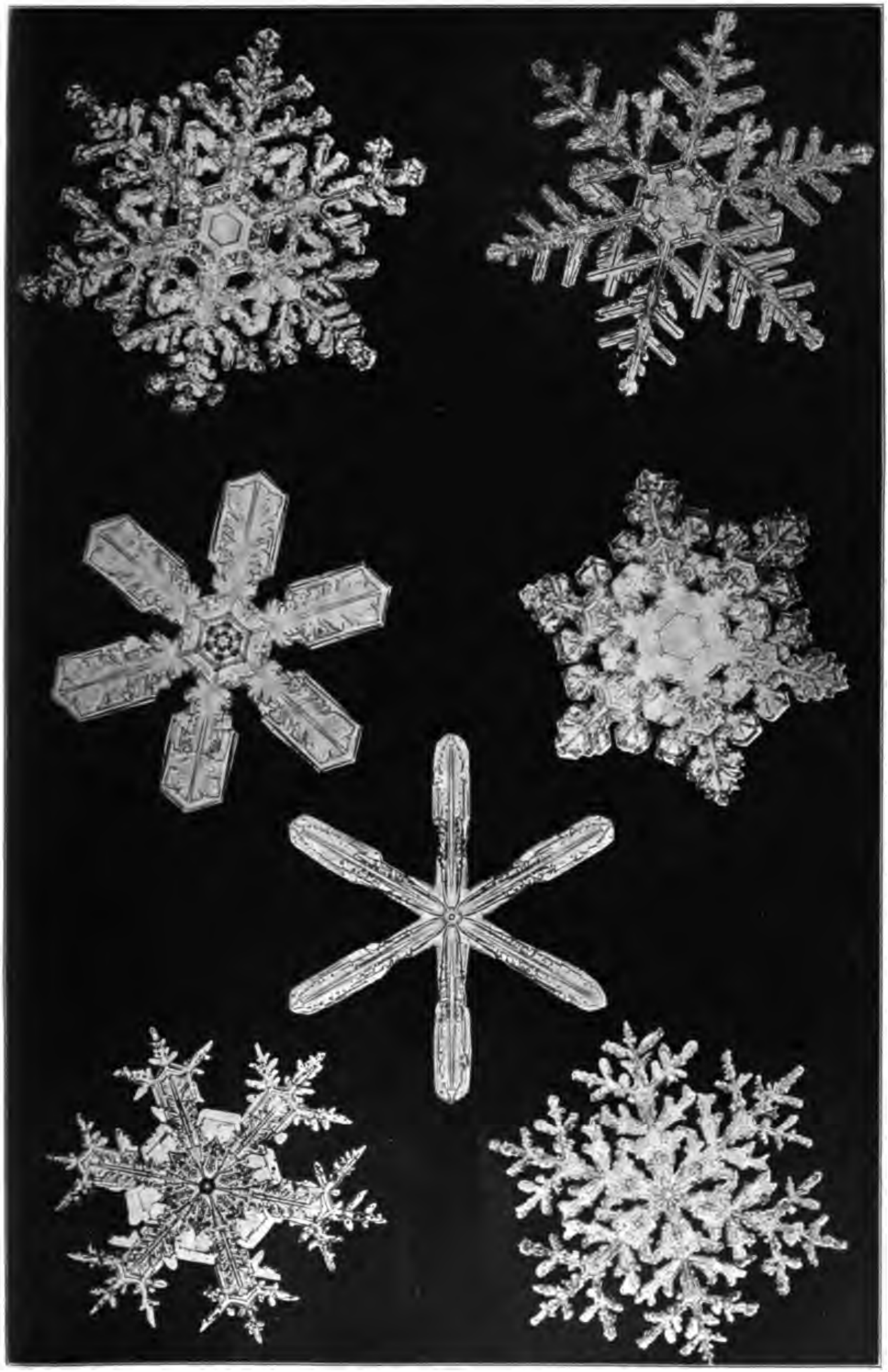
SNOW, Francis Huntington, American naturalist: b. Fitchburg, Mass., 29 June 1840; d. 20 Sept. 1908. He was graduated from Williams College in 1862 and from Andover Theological Seminary in 1866, at which time he was called to the University of Kansas, then established, as professor of mathematics and natural history. In 1886 Snow Hall of Natural History was established in his honor, and in 1890 he was made chancellor of the university and professor of entomology. He was well known in the field of ornithology and meteorology, but especially as the discoverer of a fungus destructive to the chinch bug.

SNOW, Lorenzo, Mormon apostle: b. Mantua, Ohio, 3 April 1814; d. Salt Lake City, Utah, 10 Oct. 1901. He studied at Oberlin College, but was converted to Mormonism through the preaching of Joseph Smith in 1836, and became a Mormon elder and missionary of the Church of the Latter Day Saints. In 1849 he was proclaimed one of the Twelve Apostles of the Mormon faith, and during the periods between the migrations of his people was identified with its attempts at public education. He was the founder of Brigham City, Utah, whose industrial system he organized on the co-operative plan. In 1898 he was elected president of the Mormon Church. He translated the Book of Mormon into Italian, and was the author of 'The Only Way to be Saved' (1851); 'The Voice of Joseph'; and other Mormon books.

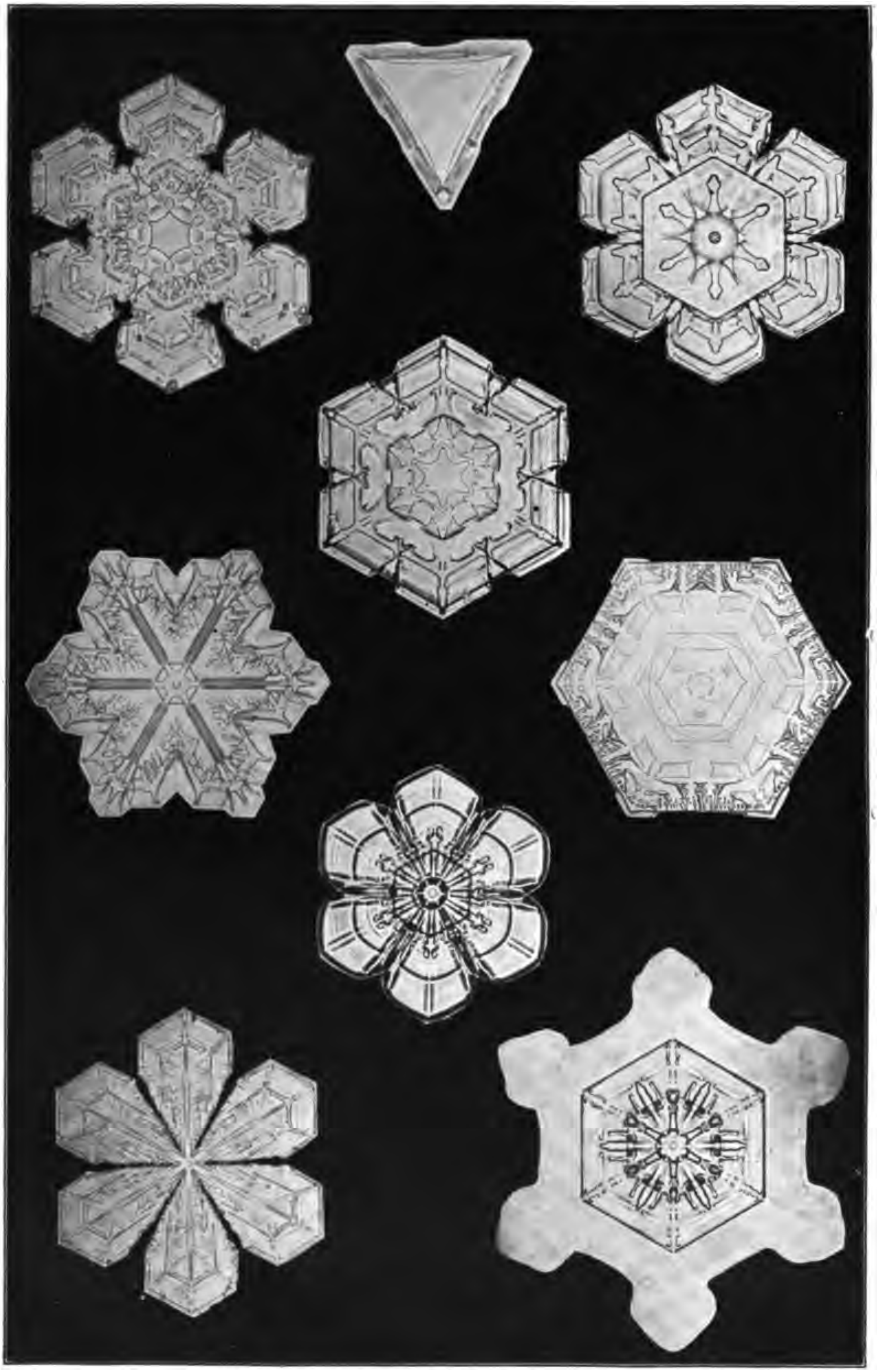
SNOW is the water in solution in the atmosphere crystallized into geometrical forms, or congealed by cold into granules or irregular particles. Snow forms usually within the clouds at various heights in the atmosphere, according to the latitude, degree of cold prevailing at a given locality, altitude of clouds, etc. It is produced in great quantity in all latitudes, though it rarely reaches the earth in the tropics (except on high mountain tops), because the heat of the lower air melts it and converts it into rain. Over the circumpolar region perpetual snow covers the earth to the depth of many feet, and on the highland areas it accumulates to so great a depth that the pressure of the superincumbent mass above causes a gradual metamorphism in the character of the mass to take place, by which it is converted into glacial ice. Below 80° of latitude for each hemisphere (the general limit of perpetual snow) snow occurs in general in ever decreasing quantities as the equator is approached, until at 30° it is rarely seen at sea level. Over the northern portion of the temperate zones, and extending equatorward from 80° to about 45°, snow commonly covers the ground continuously during the winter months, and serves a most useful purpose in the economy of nature, in protecting vegetation and the earth's surface from the intense cold of winter. Owing to many causes, both meteorological and topographical, the amount of snowfall varies greatly at different localities, even as regards those situated upon the same parallels of latitude. Upon the tops of high mountains, whether these be situated within the frigid, temperate or tropical zones, snow falls intermittently throughout each year, and above a certain height upon them, called the snow-line, remains permanently, covering the summits. Owing to local causes, and to varying meteorological and other conditions, the snow-line upon mountains varies considerably in height, even as regards mountains situated upon the same parallels of latitude. In general it approximates 1,000 feet at 70°, 5,100 at 60°, 6,800 at 50°, 10,200 at 40°, 13,500 at 30°, 15,000 at 20° and 10°, and 16,000 or 17,000 feet at the equator.

Two distinct varieties of snow occur,— the crystalline and the granular. The latter sometimes occurs as a distinct formation by itself, but more frequently as an accretion deposited by mist, or by clouds laden with minute raindrops, upon the crystalline varieties while these are passing through them on their earthward journey. Those particles wholly of a crystalline character are transparent like glass, vary in size from three-quarters to one-fiftieth of an inch in greater diameter, and fall to earth singly, or bunched together into flakes, according as to whether the temperature and humidity are low or high. In general their size decreases in a certain ratio, with a decrease in the temperature of the air, and vice versa. The majority exhibit a tendency to divide into six, due to the fact that snow crystals belong to the hexagonal system of crystallization.

The majority of snow crystals assume forms which, by virtue of outline structure or general characteristics, may be grouped into two principal classes,— the columnar and the tabular. Those comprising the former class are all such as appear in the form of hexagonal columns, long, slender, needle-shaped crystals, or columns tapering at one end. The tabular snow-crystals develop upon an extremely thin tabular plane, whether they possess open or solid structure, or both combined. These two principal types often combine, tabular crystals forming upon one or both ends of the columnar crystals, on a plane perpendicular



FORMS OF SNOW CROSTALS



FORMS OF SNOW CRYSTALS

to their main axis, and so form compound crystals.

Crystallic growths sometimes take place from minute granular snow, the latter forming the nucleii, from which crystallic additions project or ramify in many planes. During extreme cold, or when snowfalls emanate wholly from high cirro-stratus clouds, minute sub-crystalline varieties often predominate, exhibiting an imperfect or segmentary semblance to tabular or columnar forms.

The various types of snow crystals do not occur with equal frequency, or form an equal bulk of the total snowfall. The tabular crystals, and especially those of an open, branchy structure, appear the most frequently, and the others in the following order: tabular crystals possessing solid nuclei; granular snow, minute irregular sub-crystalline varieties, solid tabular hexagons, columnar crystals, compound crystals.

The columnar crystals vary much less than do the tabular ones; such variations as occur being chiefly those relating to their dimensions, rather than their structure or aspect. The compound crystals exhibit a much greater variety of form and structure. The connecting bar varies greatly in both length and thickness in the same and in different snowfalls. The tabular crystals attached to one or both ends of the columnar bar also vary greatly at different times, both as regards size, outline and structure, and these variations often apply to the tabular crystals attached to the same bar. Commonly, whenever the connecting bar is extremely short, one of the tabular crystals attached to its ends will greatly exceed the other in size, and as a result the compound crystal (resembling a cuff-button in shape) is practically converted, for purposes of descent, into a tiny parachute, the minor tabular crystal assuming the role of parachutist; and in this order the crystals fall through the air and alight upon the earth.

The most important division into which snow-crystals are divided is the tabular class, and those grouped under this head occur the most frequently, exhibit the greatest beauty and diversity of form, and form by far the larger part of the total snowfall. The variations of outline, structure, internal ornamentation, etc., of the individual crystals of this class, both in the same and in different snowfalls, are all but infinite. No written description can adequately portray the wondrous beauty, complexity and perfect symmetry of many of them; it far transcends that of the crystals of any other mineral species. They occur in three principal subdivisions, and the frequency of the occurrence of each is in the following order:

(1) Those of a wholly open structure (branchy); (2) those possessing nuclei of a close structure surrounded by growths of an open nature; (3) those whose structure is wholly close (solid). Owing to various unfavorable conditions, as violent winds and the collisions and fractures due to these, development proceeding while they are in motion (as in falling) or while they are in close juxtaposition, and to other unknown causes, the majority of the crystals of snow fail to attain perfect symmetry in all their parts. Commonly the nuclei outline a minute star, a hexagon, or a circle. The number of snow-storms depositing large numbers of beautiful and symmetrical crystals at a given locality, in the northern part of the United States, during any one winter, does not usually exceed 16, and may not exceed eight. The great majority of the more perfect and beautiful crystals usually emanate from the clouds of the western, southwestern or northwestern segments of great storms. In general, similar types of crystals occur in most storms, within corresponding segments of each, due to some law of general distribution. Each cloud-stratum, the high, the low and the intermediate, and the temperatures, air-pressures, etc., corresponding with each, seem to favor the formation of a certain type of crystal; the low clouds give large branching crystals; the high clouds, small, compact ones; the intermediate clouds, medium-sized crystals, in form a composite of the low and high types.

The feature of chief interest and importance concerning the internal structure of the crystals is the occurrence therein of minute inclusions of air and air-tubes. These appear by transmitted light as dark lines or shadings, etc., because of the absorption, interference, or refraction of the rays of light that strike or pass through them. The beautiful and usually symmetrical arrangement of these air-tubes and compartments impart to this type of crystal its principal charm. These air-inclusions are of great interest, because of the great number of distinct and varied inclusions that often appear within the same and within different individual crystals, and also because it may be assumed that they were not formed in regular progressive order, but in intermittent order from the nuclei outward, while each new and distinct outgrowth was being added to and arranged upon and around the growing crystals; and hence they outline the boundaries of each of the many pre-existing shapes the crystals successively assumed in cloudland.

Hundreds of drawings of this variety of snow crystal have been made by various observers, among them Dr. Scoresby and James Glaisher of England, Prof. S. Squinabal of Italy, and Mrs. F. E. Chickering of Portland, Maine. Many of these have been published in textbooks and other publications. More recently the aid of photography has been invoked in securing and perpetuating the likenesses of these beautiful but fleeting forms. During the winter of 1902–03 Dr. Neuhauss of Berlin secured microphotographs of them, and about the same time Herr Sigson of Russia and Dr. Nordenskiöld of Stockholm also secured microphotographs. Many of these were published in the *Meteorologische Zeitschrift* for 1894, in a paper issued by the Geological Society of Stockholm, and also in a book by Dr. G. Hellman, entitled ‘Schneekrystalle.’ The pioneer in this work, however, seems to have been W. A. Bentley of Jericho, Vt., who began the photographing of them during the winter of 1885. By the spring of 1904 the microphotographs secured by him numbered over 1,100, no two alike. Many of these were published in a publication issued by the United States Weather Bureau, entitled ‘Studies Among the Snow Crystals, Winter of 1902.’ These photographic studies, in connection with the meteorological ones made simultaneously, have greatly increased our knowledge of these most interesting crystal forms.

The manner in which the snow crystals form is this: They crystallize in a liquid (the air) of small density, which is often in a state of agitation where the crystals are forming, and whose degree of density, humidity, etc., is ever changing; and usually among a multitude of uncongealed or uncrystallized particles of vapor, called cloud. The commonly accepted theory is that these visible cloud-particles unite to form the true snow-crystals. This is doubtless true, in so far as the granular varieties are concerned, but the true crystalline varieties probably form direct from the invisible water-molecules floating in the air, before these unite to form the vastly larger cloud-particles. It is possible that the cloud-particles are essentially the dross, residue, or excess of moisture left over during the process of crystal-building. A portion, at least, of this residue or excess of moisture ascends, and is congealed in the upper air, into the semblance of minute snow-crystals; appearing in the form of the cirrus cloud above, and often around all storms of great duration or magnitude. Many occurrences are on record of snowfalls occurring from skies clear or nearly free from visible clouds, and this lends additional weight to this theory. So very light are many of the snow-crystals, especially while they are in a nuclear or uncompleted state, and so strong are the expanding, uprushing air-currents within many portions of great storms, that it must be assumed that many crystals are wafted upward, perhaps repeatedly, and acquire growths at greater altitudes than that wherein the nuclei originated, before they attain sufficient weight to fall to earth. Doubtless the multitudinous changes of form and structure that many of the crystals undergo within the clouds during growth are due to these many vertical and horizontal flights within the clouds and to the great and ever-changing variety of meteorological and other conditions prevailing therein, each of which impresses its especial condition upon them.

The production and deposition of the snow, occurring, as it does, over so large a portion of the earth's surface, are phenomena of great magnitude and importance. Snow not only changes the whole aspect of nature but it also serves many useful purposes. It conserves the heat of the earth and protects vegetation from the intense cold of winter and even in northern regions, where deep snows occur, it is not considered a serious impediment to travel or commerce. A track once made, the compacted snow affords an excellent roadbed, over which heavy loads of merchandize can be easily and quickly transported on sleighs. But while in the abstract its manifestations are beneficent, in the concrete, some of them are otherwise. Much damage often results from the great inundations caused by the sudden melting of deep snow over large areas, and its sudden accumulation to great depths often causes a temporary blockade of railroad service and travel in general. A large fall of damp snow or sleet sometimes accumulates so heavily upon telegraph and telephone poles and wires and upon the limbs and smaller trees of the forests, that they break under the great weight. Snow-slides from the steep sides of mountains sometimes occur and bury and destroy whole villages. Altogether the snow fills a most important place in nature's plan. Not only is it beautiful in itself, composed of the most graceful crystal forms that occur in nature, but it plays an important part in beautifying earth and sky, forest and mountain.

The measurement of snowfall is often a matter of considerable difficulty, on account of the drifting caused by the winds. Various types of gauges are used to collect the snowfall over a given area and measure the amount of water formed by its melting. Hollow tubes are used to gather and weigh fallen snow so that the total amount of snow over a given area may be estimated. Stakes planted in the ground are also employed for this purpose.

W. A. Bentley,
Author of ‘Snow and Snow Crystals.’

SNOW-BALL. See Guelder Rose.

SNOW-BERRY, a name applied to several white-fruited plants, among them the rubiaceous *Chiococca alba* of tropical America, a climbing plant with yellow flowers and white berries. It has medicinal properties, and the root, known as calunca-root, was used as a diuretic. The cultivated snow-berry (*Symphoricarpus albus*) is a small, smooth, much branched shrub of the honeysuckle family, common in North America. It has opposite oval leaves, and inconspicuous rose-colored flowers in racemes, often leafy. While of somewhat sprawling habit, snow-berries are valuable because of their power of increasing rapidly by suckers, and for their ornamental white, pulpy berries, borne in such abundance as to bend down the slender branches, and retained far into the winter. The creeping snow-berry is another northern plant (*Chiogenes hispidula*), an evergreen trailing shrub, found in sphagnum bogs and mountainous evergreen woods. It is pubescent, with alternate two-ranked ovate leaves, and axillary, small, white flowers, succeeded by somewhat dry white berries. The whole plant has the aromatic taste of sweet birch.

SNOW-BOUND. ‘Snow-Bound; a Winter Idyl’ (1866) was written by Whittier immediately after the close of the Civil War. The lifting of a great pressure of anxiety left him free to be idyllic, which he could be all the more movingly because of the recent deaths of his mother and sister, deeply-regretted links with the past, which he perpetuates. Few poems unite with so much tenderness, so much accuracy. ‘Snow-Bound’ can be called nothing less than the classic picture and epitome of rural New England during its golden age. The sturdy, simple family shut in by the December snow storm includes most of the types native to that region: the «prompt, decisive» father who knows Canada and the sea, and by his adventurous tales brings half of New England to the winter fireside; the busy mother, full of memories of her own girlhood, of legends of Indian raids, and, still more remote and venerable, of Quaker antiquities as recounted in «painful Sewel's ancient tome»; the uncle, «innocent of books,» who knows the lore of weather and cloud and bird and muskrat in a way which points forward to that village naturalist of genius, Thoreau; the maiden aunt, sweet, devoted, cherishing the «virgin fancies of her heart»; the schoolmaster, a young Dartmouth student who, adaptable and at ease, brings into this plain neighborhood the love of learning and truth; and finally the guest, the lovely and eccentric woman marked by the touch of wildness, nearly madness, that now and then flashes from beneath the surface of New England sobriety. These Whittier describes, and their occupations during the week of close embargo, with the fidelity of affection; while even above his truthfulness to outer fact rises his truthfulness to the deeper spirit of New England, its homeliness, its stability, its aspirations, and its inviolable confidence in high and good things. The style of the poem is limpid and flexible, now Flemish in its unadorned detail, and now radiant with mystical fervor.

Carl VanDoren.

SNOW-BUNTING, or **SNOW-FLAKE,** a large bunting (*Plectrophenax nivalis*), common in the northern regions of both hemispheres, and visiting the United States and central Europe in flocks during the winter. They haunt the open, treeless wilds, and place their nests on the ground or in the crevice of a rock throughout northern regions. Their long hind claws serve to distinguish them from the true buntings, giving them a certain similarity to the larks, which they also resemble in running swiftly and in never perching (see Longspurs). In winter the plumage of the male is almost or quite pure white. The summer dress exhibits a tawny brown hue, spotted with white, the back darker. The average length is about seven inches. The song is sweet, but faint. The Laplanders account the flesh of these birds a great delicacy; and in Greenland they are caught and dried in great numbers. They subsist largely on seeds.

SNOW-DROP, any one of the 50 or more cultivated varieties of the genus *Galanthus* (*Amaryllidaceæ*), the most common being the European snow-drop (*G. nivalis*), famous for its midwinter blooming. They are small, low plants, with bulbous roots, narrow leaves and nodding white flowers, touched with green. The corollas are somewhat bell-shaped, having six segments, the three outer concave and spreading, and the others straight and shorter. *Galanthus elwesii* is one of the largest flowered varieties. Although usually very early spring bloomers, giving the bees their first supplies of honey, some varieties appear in the autumn, and were, for a while, rare plants.

SNOW-FLAKE, any one of the species of *Leucojum,* a genus of the *Amaryllidaceæ,* resembling the snow-drops, but larger and having the six segments of the perianth equal. They are graceful, nodding flowers, pure white, except where touched with green at the tips of the petals, and are low and bulbous, with narrow leaves. *L. venum* blooms soon after the snow-drops and crocuses, while *L. æstivum,* the summer snow-flake, a species of continental Europe, blooms still later, and has several flowers on a stalk. Propagation is by offsets, and these are best removed when the leaves are dry.

SNOW-GOOSE, an Arctic goose (*Chen hyberboreus*). See Geese.

SNOW LEOPARD, or **OUNCE,** a large cat (*Felis uncia*) of the high mountains and plateaus of central Asia, where it is often found in snowy forests near the limit of timber growth, and rarely descends below 9,000 feet. It feeds on wild and domestic sheep, goats and dogs, but is not feared by the men of the region. Mivart points out its special interest as a large feline animal adapted to live in a cold climate, and says: «It is clothed in a dense long fur, which even forms a short mane. It is four to four and one-half feet long, without the tail, which measures a yard. The fur is of a pale yellowish gray, with small irregular dark spots on the head, cheeks, back of neck and limbs, and with dark rings on the back and sides. It is whitish beneath, with some large dark spots about the middle of the abdomen. The long bushy tail is surrounded by incomplete black bands.» Its fur is one of the most handsome and valuable yielded by the cat tribe.

SNOW LINE, that line above which there is perpetual snow. In equatorial regions it usually lies at a great elevation, but in polar regions it is very near sea-level. Glaciers form in most regions above snow line. See Glaciers.

SNOW-OWL, a large owl (*Nyctea nyctea*), a native of the north of Europe, Asia and America. In old birds the plumage is occasionally pure white, but in younger and most adult birds each feather is tipped with dark brown or black. The length of the adult male is about 20 inches, that of the female four or five inches more. This is one of the largest of the owls, and is at once distinguishable from the great horned owl, the only other species of equal size which occurs commonly in the United States, by the absence of ear-tufts. It breeds altogether north of the United States, and while it is quite capable of enduring the cold of Arctic winters, a larger or smaller number migrate southward, but most irregularly, every winter. During some winters it is very rare, and sometimes very common in the Middle States, and it may straggle quite to the Gulf Coast. The five to eight large white elliptical eggs are laid in a nest built on the ground in a rocky spot. This is one of the most diurnal of the owls and frequently hunts by day, its prey being hares, grouse, ptarmigan and similar mammals and birds, as well as rats and mice. See Owl.

SNOW PLOW, a machine or implement used to clear snow from roads, tracks and pathways. The simplest form for common highways consists of boards framed together so as to form a sharp angle, like the letter A in front and spreading out behind to a greater or less width. Being drawn along with the apex in front, the snow is thrown off the boards to the side of the road or path, and thus a free passage is opened for traffic. The snow plow in common use on urban street railways consists, roughly, of a heavy car on high trucks; underneath the floor of the car and before or behind each pair of wheels are huge rotary brushes, of cane, wood-fibre, or some stiff material. These brushes are set obliquely across the track, at right angles to each other, and are about two feet or a yard in diameter. When the car is in motion power is supplied (from the same source as the motive power), and the brushes rotating swiftly sweep the track clear of the snow, which is thrown to either side. This is further removed by means of side drags, or boards obliquely attached to the car and set edge up, on either side, the point of the angle which they make with the body of the car being directed to the front. Snow plows are in common use on the Western and Northern railroads in the United States and Canada. They are of many different patterns, the machinery for such purpose being improved and revised every year. They are constructed more or less on the same principle, which comprises pairs of rotary blades obliquely set in a drum casing open at the front end, and driven by horizontal shafts, the other ends of which are connected with machinery in the body of the car, from which the driving power is supplied. Such an engine is coupled to the locomotive, from which it draws the steam necessary for the operation of the plow through connecting pipes. Another locomotive is hitched behind to supply the moving power, then comes the train of cars, and, in many cases, behind these another locomotive to help in the pushing. By means of such contrivances the railroads have been enabled to operate through severe snowstorms, cutting through drifts which completely bury their tracks and which before the invention of the snow plow necessitated complete suspension of traffic. Snow plows are now in use on practically all railways in cold climates.

SNOWBIRD, a North American finch of the genus *Junco,* in which the plumage is not streaked, and the two marginal feathers of the tail are white. They are northern birds, the eastern ones breeding south of the Great Lakes only on the tops of mountains, and the several western species inhabiting Canada or the peaks of the Rocky and Pacific Coast mountains, making their nests on the ground. They appear in the middle districts about the time of the first snowfall, and remain as familiar winter residents. The common *Junco hyemalis* of the United States, east of the Missouri, is six and one-quarter inches long; grayish or dark ashy black all over the head, neck and upper parts, with the breast, belly and under tail coverts, and the first and second external tail feathers white. Western species, such as the Oregon snowbird, exhibit a greater or less amount of chestnut tints in the plumage. They utter sharp chirping notes in winter, but sing prettily during the breeding season. The name is also applied to the brambling and fieldfare or any small bird seen during snowfalls.

SNOWDEN, Ethel, English non-militant woman suffrage leader: b. 19th century. She was married to Philip Snowden (q.v.) in 1905, and became known as one of the more conservative leaders in the movement for woman suffrage. She attended the Woman's Peace Conference at San Francisco in 1915.

SNOWDEN, James Ross, American numismatist and government official: b. Chester, Pa., 1810; d. Hulmeville, Pa., 21 March 1878. He was educated at Dickinson College, studied law and engaged in practice at Franklin, Pa. He was speaker of the State legislature in 1842–44; State treasurer in 1845–47; treasurer of the United States mint in 1847–50, and its director in 1853–61. He wrote extensively on numismatics and besides many official reports and addresses was author of 'Descriptions of Coin in the United States Mint' (1860); 'The Mint at Philadelphia' (1861); 'The Coins of the Bible and Its Money Terms' (1864), etc.

SNOWDEN, Philip, English Socialist and labor leader: b. Kneighley, Yorkshire, 1864. He was employed in the Civil Service in 1886–93, afterward engaging in journalism and lecturing. He was elected to the House of Commons in 1906. He was chairman of the Independent Labor Party in 1903–06; was a member of the Royal Commissions on Canals and Waterways and on the Civil Service; and a member of the Central Control Board (liquor traffic). Author of 'Socialism and Syndicalism' (1915).

SNOWDON, snō'dòn, Wales, a mountain-range in the northern county of Carnarvonshire, extending from the neighborhood of Cardigan Bay to that of Conway. It is crowned by five ridges, of which Moel-y-Wyddfa is the highest point in Wales (3,560 feet). The range is steep on the west, but more gradual on the east. It is penetrated by many valleys and streams, the most important of which are the Cwmglas and Cwm-y-Llan. There are some beautiful lakes, which attract many visitors. Bettws-y-Cold is one of the centres of resort. An electric railway to the summit of Snowdon was completed in 1897.

SNOWSHOE, a framework loosely attached to the shoe or moccasin for giving support to the wearer in walking over soft snow, much used by the Northern Indians, the Canadians, Laplanders and other residents of countries where snow remains for long periods. It consists of a frame of bent wood, interlaced with a network of hide or sinews cut into strips. The portion where the ball of the foot would rest is more closely woven than the rest, and is strengthened by a piece of light, tough wood strapped across from side to side. The shape of the snowshoe is elliptical, being rounded in the front and drawn out to a long blunt neck at the back. Its size is usually three feet or more in length and a foot to a foot and a half in width. This large, flat surface furnishes a larger plane of resistance to the soft snow and by distributing the weight of the wearer over a larger surface than the foot does, does not break the brittle crust on the top of snow, which makes progress without snowshoes impossible. In use, the wearer may well encase his feet in moccasins and further protect them by wrappings or many pairs of stockings. This is necessary to prevent the foot from being chafed by the strap, into which the toe is passed. This strap is in the middle of the snowshoe, over the strap of wood, near the front; the heel of the foot is not attached to the snowshoe at all. When the heel is raised in walking, the snowshoe is not lifted, but remains flat on the ground, then, as the foot is lifted the toe elevates the forward part of the snowshoes and it is dragged along on the snow as the leg advances. Experts can walk on snowshoes with great rapidity, but there is a swinging outward motion that must be acquired before the novice can hope to make the shoes serviceable. When there is a light crust on the snow snowshoes allow the hunter to overtake deer, moose and other hoofed animals, whose pointed feet piercing the crust sink through the snow and make rapid flight impossible. In Canada races on snowshoes have become a regular feature of the winter sports, and records show 100 yards covered in 10 seconds; one mile in from four and a quarter to five minutes; five miles in from 31 to 33 minutes. Snowshoes are frequently highly ornamented and among some of the Indians serve as love tokens. See SKI. Consult for records the reports of 'The Montreal Snowshoe Club.'

SNUFF, a powder manufactured from tobacco and used for chewing and for inhaling through the nose. For the manufacture of the finest grades of snuff only the choicest portions of fine leaf are used, but for the ordinary commercial brands the thick, stemmy portions, the mid-rib and scrap tobacco are employed. The making of snuff is one of the most intricate processes for which the tobacco leaf is used. The peculiar aroma and fragrance in snuff are obtained by a species of fermentation induced in the leaf by packing it, moist, in large quantities and subjecting the mass to a high temperature. Snuff is either moist or dry, the details in manufacture differing only in regard to the amount of moistening undergone. The moist snuffs are known as rappees, and the dry under various names, the varieties known as Irish, Scotch and sweet snuff being common. The manufacture of French rappee has been brought to a high degree of excellence by the French government which owns large factories. The tobacco is subjected to two processes of fermentation, whereby aroma and strength are acquired, and the nicotine and organic acids removed. The leaves and stalks, moistened with salt water (to prevent putrefaction), are pressed into cakes and sliced and left in open chambers for five or six months to ferment and develop aroma, the temperature at times reaching 140° F. After that time the tobacco is ground in mills out of contact with air, in order to preserve the aroma, and the powder, rapé sec, is after damping conducted to closed wooden chambers to undergo during 10 months the second fermentation, which imparts strength to the snuff. During this fermentation the temperature is kept at from 120° to 130° F. and the snuff is frequently repacked, to ensure uniformity. Finally the snuff is gathered from the fermenting rooms into one large chamber, where it matures for one month; it is then ready for stamping into casks. The machinery used in the French factory is almost wholly automatic. Snuff is very commonly adulterated in order to increase its bulk or pungency. During its manufacture various flavoring sauces and waters are used for dampening both the leaves and the rapé sec, and in this way the flavor of the finished snuff is effected. The processes of manufacture occupy about 18 to 20 months, and in this time, by the repeated fermentations, about two-thirds of the nicotine is destroyed, the acids (malic and citric) are destroyed and the acetic acids and bases evolved leave free ammonia in the snuff. This, with the slightly free nicotine and the aromatic pungents, are desired qualities. The Scotch and other dry snuffs are commonly slightly adulterated with quicklime, which gives the biting, desiccating effect for which they are peculiar. Snuffs are scented with musk, essences of bergamot, lavender, attar of roses, tonquinbeans, cloves, orange flowers, jasmines, etc.

The practice of snuff-taking was introduced into Europe from America during the 16th century, and during this and the following century became very general throughout the Continent and in England. Its use in England greatly increased under the reign of William and Anne, and in France under the various Louis. The practice, although almost entirely abandoned by the upper classes to-day, is more widely prevalent than is commonly thought. The consumption of the drug in the British Isles is said to amount to more than 900 tons annually. In the United States, where the consumption is about 9,500 tons a year, the chief users are foreign-born. The snuff used in this country is all of domestic manufacture, the small amount of French snuff imported not being worth considering.

The habit of taking snuff is said to be one of the pleasantest ways of using tobacco. The snuff, pinched up between the thumb and forefinger, is drawn into the nostrils by sharp, deep inhalations. In a few moments it produces a ticklish sensation, which frequently causes sneezing, and is highly gratifying to the user. The habit of «dipping snuff,» at one time common among the poorer classes in the south Atlantic portions of the United States, consisted in holding in the mouth the well-chewed end of a dry twig, which had been dipped into powdered snuff. The habit is still prevalent in some sections.

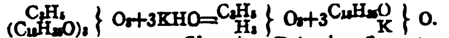
Snuff-boxes, for retaining small quantities of the powder about the person, are of great variety of shape and material. When snuff-taking was one of the habits of society these boxes were often of much value and beauty of workmanship. Gold, silver and precious stones were employed in their manufacture and some of the boxes of crowned heads and of the popes are famous for their workmanship. The ordinary boxes used by the snuff-takers to-day are of horn, papier-maché or lacquered wood and are made largely in France and Germany.

SNYDERS, snī'dĕrs, **Franz**, Flemish painter: b. Antwerp, 1579; d. there, 19 Aug. 1657. He studied under Brueghel, the younger, and Hendrick van Balen. In 1602 he was elected master of the Guild of Saint Luke. In his early life he painted fruit and flowers. Rubens engaged him to paint still-life accessories in his pictures, and in turn Rubens often painted the figures for Snyders' canvases. His pictures are found in all the great galleries of Europe. His masterpiece, 'Two Lions Pursuing a Roebuck,' is on exhibition at Munich.

SOANE, sōn, **Sir John**, English architect: b. Whitchurch, near Reading, 10 Sept. 1753; d. London, 20 Jan. 1837. He was a mason's son, and was for a time an errand boy, but having gained some architectural knowledge, won first the silver medal (1772) and afterward the gold medal (1776) of the Royal Academy, the latter for a design of a triumphal arch. In 1788 he was appointed architect to the Bank of England, and in 1791 clerk of works to Saint James' Palace, the Parliament Houses and other public buildings. He was elected A.R.A. in 1795 and R.A. in 1802 and became professor of architecture to the Royal Academy in 1806. He was knighted in 1831 and at his death bequeathed his collection of works of art and $130,000 to the nation. The Soane Museum thus formed is housed at 13 Lincoln's Inn Fields, London, and contains antique sculptures, bronzes, gems, models of ancient buildings, a collection of pictures, etc. Consult 'Memoir' by Britton (1834). He published plans of 'Public and Private Buildings' (1828).

SOANE MUSEUM, The. See SOANE, SIR JOHN.

SOAP, a chemical combination of fats and alkali, used as a detergent. The cleansing properties of these compounds have been known for a very long time; the manufacture of soap upon a large scale dates only from about 1823, in which year Chevreul published his famous researches upon the animal fats. The natural fats — palmitin, stearin, olein, etc.— are acid ethers of glycerine. Glycerine is an alcohol containing three atoms of replaceable hydrogen, its formula is $\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}O_3$; in the fats these three hydrogen atoms are replaced by the radicles of various acids, chiefly of palmitic, stearic, margaric and oleic acid, and thus are obtained the glycerides of these fatty acids, or, as they are commonly called, the fats palmitin, $\left.\begin{matrix}C_3H_5\\(C_{16}H_{31}O)_3\end{matrix}\right\}O_3$; stearin, $\left.\begin{matrix}C_3H_5\\(C_{18}H_{35}O)_3\end{matrix}\right\}O_3$; margarin, $\left.\begin{matrix}C_3H_5\\(C_{17}H_{33}O)_3\end{matrix}\right\}O_3$; and olein, $\left.\begin{matrix}C_3H_5\\(C_{18}H_{33}O)_3\end{matrix}\right\}O_3$. If these fats be heated with caustic alkalis they are decomposed, a union taking place between the particular acid, the radicle of which exists in the fat, and the alkali while glycerine is at the same time produced; thus with stearin and caustic potash the reaction may be formulated:



$$\left.\begin{matrix}C_3H_5\\(C_{18}H_{35}O)_3\end{matrix}\right\}O_3+3KHO=\underset{\text{Glycerin,}}{\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}O_3}+3\underset{\text{Potassium Stearate,}}{\left.\begin{matrix}C_{18}H_{35}O\\K\end{matrix}\right\}O.}$$

The salt of the fatty acid so produced (in this instance potassium stearate) is called a soap. Soaps, therefore, may generally be defined as the metallic salts of the higher fatty acids, and the process whereby these salts are produced from the natural fats is called saponification. Although this includes under the name soap all the metallic salts of the higher fatty acids, yet in common usage the name is limited to the sodium and potassium salts of these acids.

Soaps are also produced by treating certain oils with caustic alkalis; these oils are of the class known as fixed oils, so-called because they cannot be distilled without decomposing. Oils which may be distilled, as the essential oils and mineral oils, are not available for soap-making.

The essential parts of a soap then are (1) the alkaline metal and (2) the fatty acid which it contains; upon these two the quality of the soap depends. Speaking broadly, two kinds of soap are made for the market: hard soap and soft soap. In the former type, soda is used as the combining alkali; in the latter, potash.

Materials.— The oils and fats in economic use for the manufacture of soap may be divided for discussion into five groups or alliances: (1) coconut oil and palm-kernel oil; (2) olive oil, olive oil foods, cottonseed oil, peanut oil, sunflower seed oil and corn oil; (3) tallow, greases and palm oil; (4) castor oil and linseed oil; (5) red oil and resin. The oils in the first group saponify very quickly at ordinary temperatures upon the addition of cold concentrated caustic soda. During the action great heat is evolved. A larger yield of firm soap is obtained from these oils than from any others. They are, however, rarely used alone, but are added to tallow and cottonseed oil, and this combination results in a superior grade of soap, better than can be made from either of the ingredients alone. Their glycerine content is higher than in any other group, amounting to 12 per cent. The second group is composed chiefly of glycerides of oleic acid. They yield a thin soap, very soluble in water, and make good toilet and textile soaps. The well-known green Castile soap, when pure, is made from olive oil. Their glycerine content is about 10 per cent. The third group are glycerides of (principally) stearin and palmitin, and yield a firm soap of good body, dissolving slowly in water; much improved by the addition of oils from the first and second groups. The oils of the fourth group saponify readily, yielding highly soluble soaps of a pale brownish color, useful in making transparent soaps. The acids of the fifth group combine directly with caustic soda. They are used only in combination with other groups.

In the last few years the process known as hydrogenation has made oils which had been unavailable for soaps a very important factor in the raw materials market, which had been seriously narrowed by the demand for all edible oils by the manufacturers of oleomargarine and "nut butter." By this process oleic acid is converted into stearic acid by passing a current of hydrogen gas through it in the presence of reduced nickel, while at the temperature of about 550° F. This process is applied chiefly to cheap fish oils — which lose their objectionable odor during the treatment.

Manufacture.— Soap is made generally by one of three processes: (1) that in which the glycerine of the fats is set free and separated out; (2) that in which the glycerine is set free, but not separated; (3) that in which there is direct saponification and no glycerine is produced. More than 90 per cent of the soap produced is made by the first plan, the by-product glycerine being very valuable. The oils and fats in predetermined proportions are measured into the "kettle," a large cylindrical tank which may be as much as 25 feet in diameter and 30 feet deep. This kettle has an open steam coil in the bottom to supply the heat. Part way up the side is an outlet pipe with a valve through which the crude soap is drawn into the crutcher after the saponification is complete. At the bottom of the kettle is another outlet through which is drawn the watery residue after the soap has been separated out. Following the charging of the kettle with fats a measured portion of a dilute lye made with caustic soda is run in and the steam turned on, and the contents of the kettle vigorously boiled. As the soda unites with the fat more lye is added at intervals, care being taken that at no time until the saponification is almost complete shall there be an excess of alkali. When the contents of the kettle appear clear and homogeneous, dry salt is shoveled in. As soap is but sparingly soluble in brine the action of the salt is to separate the mass in the kettle into two layers, the upper one being of the separated soap and the lower one a mixture of brine, glycerine and excess lye. This step in the process is called "graining" because of the granular appearance of the soap. The amount of salt necessary depends upon the kind of oil and fat used as the raw material, some fats requiring much more than others. The salt is added in small instalments until the separation is complete. After standing several hours the lye is drawn off from the bottom of the kettle and clear water turned in. If the soap is to have an admixture of resin, it is added at this stage. A proportion of caustic soda is added to remove impurities, and the boiling is renewed, and the soap again becomes a clear mass. It is salted out a second time, and the process repeated, if it seems desirable, with the addition of lye only. The next step in the process is "fitting." Water is added by degrees and boiling continued until the soap gains the proper appearance, readily recognized by the experienced soap boiler. It is then allowed to settle, which if the batch is large may take four or five days, more or less, according to the raw materials used and the season of the year. The batch is then found to be in four distinct layers: (1) a crust of "fob" or soap froth; (2) the good soap, containing 63 or 64 per cent of fatty acids; (3) the "nigre" or weak, dark-colored soap, containing about 33 per cent of fatty acids; (4) watery lye. In making cheap soaps the second layer is run directly into the soap "frames"—casings in which it stands until cold and solid. For a finer grade it is run first into the "crutcher," a mixing machine, where it may be "filled" by adding sodium carbonate, sodium silicate, sodium borate, naphtha (up to 10 per cent), perfumes and coloring matter. After some hours of crutching it goes to the frames to solidify. Special cooling machines have recently come into use whereby the cooling process has been reduced from several days in the ordinary frames to two hours, or even less. The device consists in forcing the liquid soap into metal casings the sides of which are continually cooled by the passage of currents of cold water. By the turning of a screw the casings are released, and the blocks of soap readily removed. When hard enough the blocks are put through the "slabber," which divides them into slabs by forcing piano-wire cutters through the mass. They are then cut twice again, lengthwise and crosswise, into cakes which are placed on racks to dry. When they have dried out to the proper hardness they go to the presses, where each cake receives definite form and the imprint of the maker. Thence they go to the machine which wraps them preparatory to boxing for the market.

Toilet soaps are usually "milled," the process beginning with shaving or chipping of the blocks of soap as they come from the frames. These chips are allowed to dry hard, perfume and coloring matter are added and they are then run several times through a mill of rollers which transforms them into thin flakes while perfecting the thorough mixing of the ingredients begun in the crutcher. When the soap flakes are entirely homogeneous they go into a machine called the "plodder," a cylindrical or conical casing in which revolves a longitudinal screw. The screw forces the soap forward under great pressure and it is finally exuded through a form plate in a continuous bar having the outline of the cake in which it is eventually sold. The bar is cut into sections of the proper size and these receive their final shape in a press.

The second process of soap-making, in which the glycerine is set free but not separated, is used in the manufacture of soft soaps. Large quantities of soft soap are used in the textile industry. They are made chiefly of linseed oil, corn oil, whale and fish oils and in the finer grades of olive oil. Special white soaps are made with cocoanut oil and some tallow. As previously noted the lye used in making soft soap is made from caustic potash. The lye is added by degrees as in making hard soap, and the boiling is done with a closed instead of open steam coil. The color of the finished soap depends largely upon the kind of oil used, but to a considerable extent upon the care taken in the making. Good soft soap contains about 43 per cent of fatty acids, 10 per cent of alkali and 47 per cent of water. In some grades a percentage of saponified resin is added, but this is highly objectionable in certain textile soaps, and the practice is, therefore, limited.

The third process, that in which the glycerine is not formed, is known also as the "cold process." The soap is not boiled, the oils and alkali being carefully proportioned to form complete neutralization. While this process was formerly restricted to cocoanut oil, it has proved workable with other oils and fats when the lye is made strong. It is required, however, that the fats be absolutely clean, as all of the ingredients remain in the soap. The caustic, also, must be of the highest grade of purity. The fats and oils are warmed to the melting point and a little beyond, and placed in a crutcher, the lye, heated to 80° F., being run in gradually with constant stirring. Replacing a part of the soda lye with potash, up to 20 per cent, improves the soap. When the appearance of the soap indicates that saponification is well established, the soap is run into the frames and left to stand for a week, being covered to prevent it from cooling too rapidly. This method is very popular with makers of toilet soaps, as it is available for small batches, and does not require the costly equipment of the soap-boiling plants.

Specific Properties.— Silicated soaps are produced by mixing silicate of sodium (soluble glass) with ordinary soap. These soaps are cheaply produced, and have very considerable detergent power.

Toilet soaps are produced by perfuming the best ordinary curd-soap with essential oils, or sometimes by saponifying lard, beef-marrow or oil of sweet almonds with caustic soda-lye, in the cold and perfuming the products. They are preferably made of vegetable oils which lather freely.

Shaving soap is made of cocoanut oil as a base with some stearic acid to give hardness. Both soda and potash lyes are used and gum added to prevent its drying quickly. Glycerine is a common ingredient and often a little sugar.

Castile soap when pure is made of olive oil and a soda lye. It soon becomes very hard, however, and to remedy this cocoanut oil or linseed oil is used in the mixture. The cheaper grades of Castile soap are made from cottonseed oil.

Light or floatant soap is produced by agitating a solution of soap, to which a fifth or sixth part of water has been added, until the lather has risen to a considerable height, and then transferring it to a mold, where it remains until the quality of transparency is fixed.

Transparent soap is prepared by drying ordinary soap, dissolving it in alcohol, allowing the solution to remain at rest so long as any impurities are precipitated, decanting off the alcoholic liquid and evaporating it until it is of such a consistency as to solidify when cooled in metallic molds. Many kinds of transparent soaps are made by the cold process, the transparency being accomplished by the addition of sugar. Glycerine is often incorporated with transparent soaps for emollient effects, while for disinfecting purposes carbolic acid, coal tar, eucalyptus oil and other substances are added.

Mottled soaps are produced by mixing mineral coloring-matter with the soap during a certain stage of the hardening.

Medicated soaps contain antiseptics, such as carbonic acid, creosote, chloride of potash and sulphur, mixed with ingredients. A soap for the use of taxidermists in preserving skins is produced by the addition of arsenic. A large industry has developed in this country in scouring-soaps, which are produced by the addition of fine sand or pumice-stone to the ordinary soap when in its plastic state.

Soap powders are made by mixing dry sal soda and borax with hot liquid soap, with the addition of a definite proportion of hot water, sufficient to provide the necessary water of crystallization to the soda in its subsequent change. The mixture is stirred constantly until lumps begin to form, when it is piled in trays where the soda completes its crystallization. It is then milled to powder form.

History.— The use of soap is of great antiquity. A well-equipped soap factory was found by the excavators of Pompeii. Historical records of Italy and Spain show that soap was in use in those countries in the 8th century. It was known in France in the 12th century and in England in the late 14th or early 15th century. In 1622 James I granted a monopoly to a soap-maker under which he was allowed to make 3,000 tons a year, and paid $100,000 a year for the privilege. In 1711 a tax of one penny per pound was laid upon the soap produced by English soap-makers, and in 1816 this tax was increased to three pence per pound. In 1833 it was reduced to one and one-half pence, and this tax when abolished in 1853 was bringing annually into the British treasury a revenue of more than $5,000,000.

Soap-making in America.— In the American colonies soap-making was at first largely a household art, the housewife utilizing the fats saved from the dripping-pan to make soft soap for her own use, and also even a sort of hard soap, of a quality, however, that would not suit the housekeeper of to-day.

As early as 1608, on the second ship from England to the Jamestown colony, came a number of Germans and Poles, skilled craftsmen, among whom were several proficient in handling fat and soap-ashes. In 1621 soap-ashes for export to England were worth from six to eight shillings per hundredweight, and 50 years later the settlements now included in Maine and New Hampshire derived their chief wealth from soap-ashes and fat. While there were small soap-boiling establishments in nearly all the large towns by 1795, their aggregate product probably did not exceed $300,000 in value. The discovery by Nicolas Leblanc (q.v.), about 1791, of a process for manufacturing soda on a large scale was utilized some 30 years later, when chemical manufacturers and soap-makers began to avail themselves extensively of the supply of soda thus cheaply afforded.

Among the early establishments of the soap trade one of the largest was that of William Colgate of New York, founded in 1806. Fancy soaps were at this time unknown, and the makers of the American product contented themselves with a very common grade of soap; but so rapid was the advance that by 1835 they were supplying nearly all the home demands and were also heavy exporters, principally to England.

About 1850 American manufacturers were employing substantially the same methods and processes that were used in England. New England was then the principal centre of the manufacture for the United States, although New York and Philadelphia were gaining prominence. At that time filling materials were practically unknown and «settled» soaps were merely run into the wooden frames and crutched for hours, until rendered thick from cooling, or were finished by boiling down. The material was ladled by hand from the kettles into the frames, or put into buckets or tubs and carried and emptied into the frames. The kettles themselves had cast-iron bottoms, to which a wooden curb was fastened by means of cement. The composition of this cement, which was used to prevent leakage, was regarded at that time as a great trade secret, especially when the cement was capable of preventing the leakage for some length of time. The waste lye was run off through a pipe reaching through the wooden curb to a point near the bottom of the kettle. The kettles were heated by open fire, and the contents were kept from burning by stirring them with a long iron rod flattened at the end. The lye was made by leaching wood-ashes, since the use of caustic soda had made very slow advances.

While processes and methods were thus, comparatively speaking, at a standstill during the first four decades of the 19th century, the soap industry nevertheless steadily advanced in importance and prepared itself for the wonderful development that immediately followed the discoveries of Chevreul. That chemist demonstrated the true principles of saponification, and no later improvement, whether in the introduction of the steam processes or in the discoveries and uses of the many new vegetable and animal oils, has been of greater importance. Of the total soap produced at this time Massachusetts was credited with over one-quarter. Five years later the soap industry had grown to great proportions. The manufacture of fancy soaps had already been begun, and in 1850 was established on an extensive scale. Shaving soap, always in great demand in those days, when beardless faces were the rule, was also greatly improved in this decade, and many other of the common toilet necessities of to-day were either first brought out or developed to comparative excellence at this time. Soon soap-making was facilitated by the introduction of machinery and now there are specially constructed machines designed and adapted for almost every step in the different processes of manufacture where their introduction has been of advantage. At present American soaps are strong competitors in the markets of the world, and in quality they rival the best of European production.

The introduction of sapolio marked a new era in the soap business. It was a combination of true soap and scouring substances in such proportions as to increase to the highest point the advantages of each. The Bath brick of the scullery has gone since its advent, and the principle upon which sapolio was established is now utilized in many forms. See FAT TISSUE; SAPINDACEÆ.

Production.— The 1914 census of manufactures shows that there were in the United States in that year 371 soap-making establishments, with a combined capital of $92,871,533 and employing an aggregate of 14,172 hands, who earned in the year a total of $8,087,937 in wages. The raw materials used comprised 546,289,571 pounds of tallow; 13,225,330 gallons of cocoanut and palm oil; 16,144,786 gallons of cottonseed oil; 123,032,886 pounds of cottonseed roots; 185,310,786 pounds of resin; 55,320 tons of caustic soda, and 140,983 tons of soda ash. The cost of these materials was $88,866,786. The output comprised 2,064,228,000 pounds of hard soap — of which 169,926,000 pounds were toilet soap — and 57,002,000 pounds of soft soap. The value of the output was $127,942,441. The increase of production in the 10 years since 1904 was 47 per cent, all in the hard-soap product. The industry is centred in New York, Illinois, New Jersey, Ohio and Pennsylvania, which five States make nearly three-fourths of the entire output of the country.

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SOAP-BERRY, the common name of several species of *Sapindus* and of the fruits, which are so rich in saponin that they were employed for the same purposes as alkaline soap, before the days of that article. The Chinese prefer them even yet for cleansing the hair and delicate silks. Certain species of *Sapindus* yield also an edible pulp, although the seeds are poisonous. One species (*Sapindus utilis*) has been cultivated in Algeria for its berries, which the trees begin to bear in from 8 to 10 years, and *S. mukorossi*, another Chinese species, is found in Japanese gardens. Our two United States species have this saponaceous quality also and the berries of *S. saponaria*, indigenous to tropical America and the West Indies and even growing in Florida, are much used for washing linen, although said to be injurious if employed too frequently. See SOAP-PLANT.

SOAP BUBBLES, originally a simple experiment for pleasing children, produced by making water quite soapy and preferably warm and then dipping a clay smoker's pipe or a tube into the water, withdrawing it with a film of soapy solution of water across the aperture or bowl of the pipe. Then by blowing in the tube the bubble is formed and after it attains some size mav be shaken off and float in the air as a spherical balloon if the interior air is warmer than the outer air. A little glycerine in the soap makes them much more durable. Bubbles in their scientific aspect have been studied specially by Plateau, who, by adding glycerine in a certain proportion to the soap solution, obtained remarkably durable films and bubbles. The spherical form of the ordinary soap bubble is a direct result of the action of surface tension, the geometrical condition being that with given volume the surface must have minimum area. Thus, if two or more soap bubbles are joined, which is an easy matter, the joined surfaces are approximately a flat plane; but in reality the smaller bubble projects or curves slightly into the larger bubble, because the smaller the bubble curvature the greater the tension. One bubble may be blown within a larger one and then if gently shaken may chop through so as to hang from the larger bubble in outer contact. It has been demonstrated that this is due to electrification. With a well-soaped wire and thread it is possible to open up a soap bubble in the centre and to bring it to a ring form (like a cruller) without breaking. In making this delicate experiment all dust must be excluded. Consult Boys, C. V., 'Soap Bubbles' (in 'Romance of Science Series,' London 1900).

SOAP-PLANTS, numerous plants of various families that contain a poisonous principle called sapoin, which lathers in water, and is utilized as a detergent, both medically and for laundry purposes. The common soap-wort is the European *Saponaria officinalis*, often found in America along roadsides and railways, as a weed escaped from gardens. It is a rankly growing, smooth and shining perennial, with the characteristic, opposite leaves, in this instance broadly oval, and five-merous flowers of the pink family. The obcordate petals are long clawed, with a scale at the base of each blade, ranging in hue from white to bright-rose color, and the dense terminal corymbs would be handsome were they not marred by fading flowers and brown seed-capsules. The thick roots and leaves abound in saponin, and besides its employment in the laundry, the plant was formerly used as a cure for itch; it also yields an alterative drug resembling sarsaparilla. The cow-herb (*Vaccaria vaccaria*) also contains saponin. Soapbark or quillaia-bark (q.v.) is a stimulant and irritant drug, the brownish-white cortex of *Quillaia saponaria*, a smooth evergreen tree native to Chile, where its inner bark, reduced to powder, is a substitute for soap. *Pithecolobium* of several species are leguminous trees, one the savonette or shagbark of the West Indies, which yields other soap-barks, in demand for cleaning delicate fabrics. There are also several Chinese trees, which serve the natives for soap, especially valuable in washing silks and the hair. The fruit of *Pancovia delaryi* of China resembles the soap-berry (q.v.), and the pods of *Gymnocladus* *chinensis,* and certain species of *Gleditschias,* give more substitutes for soap. The refuse or "oil cake" of the seeds of the tea-oil tree (*Camellia sasanqua*), after the oil has been expressed, is not only employed in washing, but for catching fish. When the seeds or the oil cake are bruised and thrown into water the poisonous saponin stupefies the fish, which rise to the surface and are easily captured.

Amole is a Mexican name covering several plants having saponaceous and cleansing properties and utilized by the natives of Mexico and the adjacent regions of the United States. *Agave heteracantha* is a common example. The California soap-plant, or soap-root (*Chlorogalum-pomeridianum*), is a liliaceous plant, with wavy-edged, linear leaves and a tall branching panicle of many white flowers. The root is a bulb one to four inches in diameter, invested with dark-brown fibres. This bulb is pounded up by the California aborigines, who throw it into pools where fish have no means of escape, stupefying and capturing them. Hot soap-root is used to cleanse and heal old sores as well as in the laundry. There are several other soap-plants, as *Zygadenus fremontii* and *Leucocrinum montanum* in California, and *Acacia concinna,* the soap-nut, the pods of which are used in India as medicines and detergents, especially in hair washing.

SOAPSTONE. See TALC; MINERAL PRODUCTION OF THE UNITED STATES.

SOBAIPURI, a former tribe of the Piman stock of North American Indians in the main and tributary valleys of the Rio San Pedro and Rio Santa Cruz and on the Gila between those two streams in southern Arizona. The Jesuit missions of Guevavi Suamca and San Xavier del Bac were established among them in the latter part of the 17th and the early part of the 18th centuries, but owing to the depredations of the Apaches they were forced to abandon their rancherias and to join the Pimas, by whom they were absorbed.

SOBAT (sō-bät') **RIVER,** Africa, a tributary of the White Nile, rising in southwestern Abyssinia, at an elevation of about 7,000 feet, flowing westward and joining the main stream about 450 miles south of Khartum. It is a wide, deep and rapid stream, bringing down large quantities of sediment of a whitish color, whence, probably, the name of the White Nile. At one point it passes through a canyon 2,000 feet deep, the adjacent mountains rising nearly 4,000 feet above the waters. At the confluence the two rivers meet each other from opposite directions, and the sluggish current of the White Nile is often stemmed and forced back by that of the Sobat, forming a temporary lake.

SOBBING, a convulsive heaving of the breast; heavy sighs attended with weeping. It is essentially a respiratory act, depending immediately on nervous irritation, and caused by spasmodic movements of the diaphragm or midriff, but ultimately due to strong emotion, usually painful, though often merely hysterical. In sighing the glottis is temporarily closed and thus prevents entrance of air into the lungs.

SOBIESKI, sō-byĕs'kē. See JOHN III, SOBIESKI.

SOCAGE, sŏk'āj, or **SOCCAGE,** a tenure by any certain and determinate service. It is of two sorts — free socage, where the services are not only certain but honorable, and villein socage, where the services, though certain, are of an humbler nature. It has practically disappeared in the United States by the development of State legislation, but under the English system of land tenure still exists in some quarters. It appears a bad business arrangement between landlord and tenant, as certain service may be performed in lieu of rent, nearly always an irksome condition. It was very common in mediæval England.

SOCIAL BRETHREN CHURCH, The, a religious organization formed in 1867 and comprising churches and congregations in Illinois, Arkansas and Missouri. The Confession of Faith published in 1887 provides for Baptism and the Lord's Supper as in other Evangelical churches. The Church has ordained and licensed ministers and also exhorters, stewards and deacons.

SOCIAL CENTRES. The term social centres is specifically applied to the special institutions which have quite recently developed in this country, but in a broader sense comprises also the *wider use* for social purposes of *existing* institutions, such as the school and Church.

The movement in either of these forms represents a new and important step in the institutional life of the United States and one of great significance for the future. It is widespread and powerful in scope, being active in not only the greater cities and the open country, where the need for such is more specially apparent, but is gaining strength in the towns and villages. In general, it expresses and embodies the growth of neighborhood or community feeling and furnishes a common focus for the activities which result. The need for such is well-nigh universal and urgent. Already strictly private and commercial enterprises and interests has sought to pre-empt this social field The function is too vital for such to be allowed. The social centre must be public and affiliated with the deepest and soundest interests of our common social life.

The need for such is apparent when it is seen that American life presents a multitude of social centres for the greatest variety of social activities, religious sects, fraternities, clubs and associations of all kinds. Both the activities and the meeting places are multitudinous. The variety of such is one of the most characteristic features of American life. But they tend to disintegrate the neighborhood and the community rather than to draw it together, and only to further enhance the already over-developed individualism which lies at the base of so many of our problems of social and civic life.

This general condition is, of course, the result of the eclectic composition of our people, gathered from all the peoples of the earth, of all religions and languages, traditions and habit. Not only so, but the expansion and numerical growth of our population, ever spreading into new country and building new communities and neighborhoods, with ever coming and going people, has promoted a strong individualism. The break-up of neighborhoods and families, the difficulty of common feeling and interest, alike in the city and open country, has been great. The result has been an astonishing variety of social institutions, which have often tended to further increase, or at least to maintain in existence, separative forces.

The early rise and greatly growing number and form of the fraternal organizations in the United States is one evidence of such a condition and the need for social linkages. These have now attained a membership of more than 16,000,000 adults, mainly men, thus comprising a very large proportion of our adult male population. They include every variety of type and purpose, and the more important of them are practically universal. Their lodges and halls are local social centres of great importance and usefulness.

To these should be added the college fraternities and the vast number of miscellaneous social fraternities and clubs, with somewhat similar purpose. These latter do not maintain separate quarters, but, therefore, only the more increase the demand for social centres. All such, including the specific fraternal societies, are distinctly social in purpose and exist for the benefit that comes from fraternity in an individualistic and separatistic society.

From an early date the public school has seemed to many to be the most vital embodiment of the common life of our people. The beginnings of the movement for specific social centres has been closely associated with its peculiar nature and possibilities as such. There are some 280,000 public school buildings (3,000 additional ones each year) and some 12,000 high schools. They are thus practically *universal,* being located at most a few miles, and nearly always not more than as many blocks, from every American home in the land. They are the first public structures erected in new communities and neighborhoods, and are more and more liable to be the best building in the community. They are essentially public, supported by public taxation to the amount of nearly $750,000,000 per year. They are the daily gathering centre for nearly 20,000,000 children — «all the children of all the people» — of from 5 to 18 years of age. The private school has had only a slight development as yet under our conditions. Much that is best in the common feeling and interest of every American county or neighborhood is embodied in the school and educational policy. There are difficulties, indeed, in the way of making the school into *the* social centre, but it has always been, and is every day much more, serving as *a* social centre. The tradition of its wider use is strong, for in the early days in the new communities it served as church, meeting-house, polling-booth, as well as school and many other social purposes for which with the time special buildings have come into existence.

Nor is the *church* without its claims to be considered as a social centre in a way not unlike the school. There are some 15,000 Roman Catholic churches and nearly 175,000 Protestant churches and meeting-houses. Like the school, the church is universal. Its tradition as a social centre is longer historically and it has advantages over the former of being an adult association and centre and in appealing to wider range of life-interest. The development of the Sunday school and of week-day meetings has also greatly extended its capacity and social significance in the last generation. Much earlier than in the school, the churches saw their social duty and the opportunity for social service in a society like ours. The *institutional church* was in existence long before any *wider use of the school plant* was conceived. As a result the church adapted its architecture and arrangements sooner and developed power as a social centre. The greater use of the church plant was also more apparent than even in the case of the school. It is fast becoming a very convenient social centre building, for the Catholic Church has developed its separate parish-houses for the like purpose. The modern institutional church thus serves the need for an auditorium, as well as for the miscellaneous recreative and convivial activities of the community. And not only the physical arrangements but also the current spirit of religious work increasingly tends toward the ideal of *social service.* It, too, has conceived the purpose of becoming a neighborhood, or even community centre, for social service. Denominational divergence is its chief limitation in this relation, but the large unchurched masses of our populations, alike in city, village and open country, give large scope to such purposes. The specific *community church* of definitely *social service* methods is becoming increasingly common. Church federation, in various forms, and interdenominational action for many purposes, are fast rendering the accomplishment of the church's purpose to become a social centre more and more feasible.

More recently the great fraternal orders are making their claim to serve as a social centre. The lodges are broadening their membership in various ways to include women, and the more recently organized ones are showing a strong tendency to be more broadly social in method rather than strictly secret or narrowly fraternal. Often, too, their halls are in wide and frequent use as the most available place for miscellaneous social gatherings.

Our communities have, it is true, not yet developed the town-hall or *civic centre* as of the European type. The town-halls of New England and of the North Central States, where its institutional influence has extended, in a minor way often serve this purpose. But for the country in general there is as yet no sign of such a development. The *civic centre* is probably a long way off in our institutional development, although it may some day crown our efforts toward social centres.

In the open country the *grange* is the most widespread of social organizations and its thousands of halls, especially in the North and East States, approach somewhat to the character of social centres.

So the *social settlements,* which have been established in various parts of the great cities, with the object of furnishing neighborhood centres, have, in a sense, pioneered the movement in urban populations. City churches and school administrations have been foremost in the same direction also.

A favoring condition in the creation of urban social centres is the formation of *neighborhoods.* Neighborhood business centres have long been in existence in our cities, and social centres of various types are fast developing. In the expansion of our great cities the communities consolidated retain much of their local feeling. As American life, alike in city and country, settles down these neighborhood ties will doubtless grow apace.

In the rural districts the passing away of open country life, remote from town and village centres, is rapid. Hundreds of villages are springing up each year in all parts of the country — most notably in the isolation of the rural life of the South — and the 10,000 villages already existing are now fully realizing their function as social centres for their farm-districts. Moreover, the new means of communication and transportation have brought the farmer closer to his neighborhood centre. The significance of the development of the village in our rural districts cannot be overestimated. For, although, in the case of many of the recently developed special community centres, they have been located in the open country, there seems little doubt that the social as well as the business centres of such districts will naturally appear in the villages. This is increasingly true of the «consolidated schools» and of the «new rural churches.» More and more the village serves as a locus for the social centres of the rural community.

Such, then, are the more normal, widespread and underlying tendencies making for the development of social centres in American communities and neighborhoods. Much more spectacular and noteworthy but really much less significant are the many *special* and local centres that have been established. Special local or personal conditions have here and there favored the appearance and at least temporary strength of fully developed social centres.

Leadership in this more specific movement should be accorded to educational administrators. E. G. Ward, who developed the schoolhouse social centre in the city of Rochester, may be regarded as the leading pioneer. The *wider use of the school plant* has become a commonplace among educators in all parts of the country. It has taken many forms, but all in the direction of making the school *a* (if not *the*) social centre. More particularly it has involved use of the building for educational purposes in other than schoolhouses. Evenings and week-ends, holidays and vacations, in fact, during fully one-half of the total available time, the schoolhouse has become useful as a social centre. This has all come about in a few decades. The conception, too, of the educational function of the school has broadened. It is now used for «play» as well as «study,» for «work» as well as for «learning.» It now gives opportunity to those whose school-education has been interrupted, and even for parents to gather that they may keep in touch with the school's work for their children.

This expansion of use and function began with the development of *evening schools*, especially for the winter months, New York City being a leader. *Vocation* schools followed, and are largely confined to the summer holidays. Vacation use of the *playground* is also now common. Another common use of the school is for *public lectures* and entertainments. Again New York City leads. Schools are also now used as evening *recreation centres* for young men and women no longer in school. Rochester has been foremost in utilizing the schools as *social centres* for adults, as men and women's civic clubs. The various school facilities, gymnasiums, auditorium, pianos, reading-rooms, useful organized athletics and games for young and old, with folk-dancing, have also been added. Especially in Philadelphia schools are use as *meeting-places* for various civic, educational and philanthropic organizations. Use of the schools for *polling-places* is also being rapidly extended and has great possibilities.

New duties and opportunities for the schools as social centres are thus being yearly conceived and made available. The policy is rapidly extending from the larger centres of leadership to the smallest towns and villages.

The leaders of the country church, in all the denominations, have furthered the movement in this sphere. Notable and successful examples of community rural churches have been created by individual personalities. Especially have the Presbyterian and Methodist Episcopal churches been active in furthering the social service ideal. The most notable ones have been in the open country under especially favoring local conditions. Village churches have frequently seen their future in serving in broader ways the social needs of their community and their rural districts. The redirection of church policy has been not less noteworthy than that of educators.

In a few communities strictly *social centres*, separate from any particular existing institution or establishment, have been created. But these are rare and are rather a foretaste of the future of the movement than an ideal to be held out for practically immediate realization. American local life is ready for *social centres* but not yet for *a social centre*, unless under very special circumstances. Those who have the movement at heart must rather seek to facilitate widespread and normal tendencies making for the realization of their purpose rather than to artificially create a premature institution.

The movement for the development of social centres is thus widespread, arising from the need of all classes of our population, and in all types of community. It has affected every type of existing social institution and almost transformed their material equipment, their spirit and method of work. It is the expression of and the answer to a most fundamental need of our unique social conditions. It has notable and active leadership and already many specific accomplishments. Few social movements in America are more securely established or making more substantial headway. See VILLAGE.

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SOCIAL CONTRACT, The. 'The Social Contract' was that one of Rousseau's important works which bore most directly on the constitution and ordering of states. In 1743 Rousseau had gone to Venice as secretary to M. Montagu and had acquired some slight practical experience of diplomacy and statecraft. Some time after he conceived a vague project of composing a treatise along these lines, and about a decade later, after the success of his First Discourse, seems to have set himself to work in earnest on an ambitious volume, ‹Political Institutions,› which remained in his mind for years but which was never finished. The work was probably distasteful to its eloquent and imaginative author because of its abstract and theoretical character and was, therefore, laid aside. As an afterthought he later revised or rewrote a section of his manuscript and published it as ‹Le Contrat Social› in 1762. This work is, therefore, essentially a fragment, and in his own mind and that of his contemporaries was set on a lower plane than his novel ‹La Nouvelle Heloise› or ‹Emile,› his treatise on education. It is in this light that it should be regarded to-day.

In writing it Rousseau intended it as applicable only to an ideal communal state of about 20,000 inhabitants whose interests and character were homogeneous. He himself warns against attempts to apply it outside this sphere. His theory involves an organic conception of the state in which sovereignty is represented as the will of the organism. More or less closely attached to this conception are several important assumptions. Government, according to Rousseau, exists by virtue of a tacit agreement with each individual governed. By virtue of this contract every individual agrees to abide by «the general will.» The individual citizen thus stipulates that on all questions and at all times it is his will that his state shall be governed by the general will. Therefore, even in cases where the particular individual is overruled by the contrary-minded majority he has the satisfaction of knowing that his fundamental principle of government is being maintained. The greatest danger of Rousseau's system lay in the fact that on this basis he developed a mystical notion that the general will, which in practice is only the will of the greater number, cannot err. He failed, therefore, to put any check on the tyranny of majorities. Much of the radical democratic theorizing of our time, like that of the recall and referendum, find their beginning in the ‹Social Contract.› Intended, as we have seen, in the first instance to provide an ideal basis for a small city state, in spite of many interesting suggestions, as a complete or final theory of liberal government on any large scale its doctrines are dangerous. Consult Vaughan, C. E., ‹The Political Writings of Rousseau.›

Christian Gauss.

SOCIAL DEMOCRACY, The. See Socialism.

SOCIAL DEMOCRACY, German. See Socialism.

SOCIAL DEMOCRATIC WORKINGMAN'S PARTY. See Socialism.

SOCIAL INSURANCE, a comparatively new term which originated within the last decade in Germany (Socialversicherung) and France (*assurance social*), to cover that field of social or labor legislation, known heretofore as workingmen's insurance, labor insurance or even industrial insurance. The broadening of the term indicates not only the tendency to extend the methods of workingmen's insurance over other groups and social classes such as the agricultural class or lower middle class, but also the desire to draw a clearer line of demarcation between this form of insurance and other branches of insurance conducted as a private business.

Though an enormous literature concerning social insurance has grown up in America as well as in Europe, no generally accepted definition exists, and the new term is somewhat more difficult to define than the older term — workingmen's insurance. In an official report published by the United States government it is defined as «the method of organized relief by which wage earners, or persons similarly situated, and their dependents and survivors, become entitled to specific pecuniary or other benefits, on the occurrence of certain emergencies.» Dr. Fr. L. Hoffman defines it — «to comprehend all efforts, methods and means to provide in conformity to insurance principles, a sufficient pecuniary method of wageworkers and others in moderate circumstances as against the economic consequences of industrial accidents, disease, incapacity for work and finally dependence in old age resulting from sickness, infirmity or even imprudence or personal neglect. The absence of a generally accepted definition results from the comparatively recent origin of the term and movement. The point of view is gradually gaining ground, however, that the term cannot be described simply on the basis of the groups to be insured, or the dangers against which insurance is provided, but largely on the basis of the methods, and the attitude of organized society, i.e., the state and its government. Thus there exists private insurance operated for profit, and mutual insurance as a form of mutual protection, but in absence of a definite governmental policy mutual insurance is not necessarily social insurance, which latter comes into existence through legislative action. Historically it holds true that social insurance is still largely workmen's insurance. That is explained by the fact that modern industrial society is based upon a system of wage labor; that wageworkers exist by sale of their labor and, therefore, depend entirely upon the preservation of their working capacity. On the other hand they are more exposed to all possible hazards because of the nature of their work and, therefore, are more in need of insurance protection. Finally the workingmen themselves have laid the foundation to social insurance through the development of mutual benefit societies through several centuries.

Divisions of Social Insurance.— The following divisions or branches of social insurance are at present recognized and exist in some countries:

(1) Industrial Accident Insurance or Workingmen's Compensation; (2) occupational diseases insurance or compensation; (3) insurance against non-industrial accidents; (4) general sickness or health insurance; (5) maternity insurance; (6) invalidity insurance; (7) old age insurance; (8) funeral benefits insurance; (9) widows and orphans' pensions or insurance; (10) unemployment insurance.

This classification is based upon the forms of insurance in actual existence. Many efforts of a systematic classification have been made, usually on the basis of the economic or physical hazards involved. Barring vice and crime or general economic inefficiency and low wages, factors of a general character with which the social insurance method does not concern itself directly, the three conditions which threaten the workingmen's family are: (1) Absence of any wage-earner through premature death, which may be due to sickness, or industrial or non-industrial accident; (2) the physical incapacity of the wage earner to earn, which may be temporary or permanent, partial or total, and may be due to old age, sickness or accident; and (3) the inability of the able-bodied wage-earner to find a sale for his labor power.

By some of the 10 forms of social insurance above mentioned each one of these three causes of destitution can be met, and destitution prevented by the insurance method of spreading the loss over a larger group, in fact, over the entire community concerned.

The admitted social insurance methods may be classified into four groups or graduations: (1) the establishment of state insurance funds or institutions through which insurance to the workingmen is made cheaper and more attractive; (2) substantial subsidy of the workingmen's insurance by the state offering to pay a part of the premium in further effort to attract the wageworkers; (3) the method of compulsion under which certain groups or classes are required to become insured by virtue of legislative enactment; (4) the method of enforced contributions from employers or industry for the benefit of the insured wageworkers.

In some social insurance systems all of these four methods may be combined, while in others only one of the four may be utilized. Modern students, however, seldom feel justified in applying the term social insurance unless at least one of these four methods is used, while in popular use the term is being somewhat improperly restricted to the compulsory methods.

Considerable difference of opinion exists whether straight governmental pensions paid out of public funds may be included under the definition of «social insurance» since they operate without any consideration of insurance principles or methods. This holds true of old age or invalidity pensions in some European countries and British colonies and widows' and orphans' pensions in many States in America.

Nevertheless textbooks of social insurance usually include these pension systems notwithstanding their deviation from insurance principles. Social insurance is not governed by the strict requirement of private insurance science. It emphasizes the «Assurance» rather than the mathematical accuracy of rates. It merges into what is known in France as «Prevoyance Sociale,» in Germany as «Soziale Fürsorge» and may be translated as «social care» of needy individuals.

History.— The origin of social insurance, at least in its modern phase, is usually credited to Bismarck, and to the acts of 1883 and 1884, by which the German sickness and accident insurance systems were established. But as a matter of fact, the elements of mutual insurance, employers' contributions, state subsidy and even compulsion were well known in Germany and partly in other countries before. The acts of 1883 and 1884 were important, however, as establishing the first national system. From Germany the social compulsory insurance movement extended to other Germanic countries, and gradually to all other European countries, until perhaps Turkey remained the only country without any social insurance legislation. The extent, however, to which this branch of social legislation expanded in each country differs considerably. See WORKMEN'S COMPENSATION; HEALTH INSURANCE; OLD AGE INSURANCE AND PENSIONS.

The compulsory principle met with considerable opposition outside of Germany and Austria-Hungary for perhaps a quarter of a century. In opposition to it, the Latin countries, Italy, France, Spain and Belgium, experimented with the method of subsidized liberty (liberté assistée), i.e., by granting more or less substantial subsidies to stimulate voluntary insurance. The Scandinavian countries showed a tendency to follow the Latin principle. Great Britain remained indifferent, leaving the problem to the spontaneous efforts of mutual insurance, and the Slavic world neglected this as well as other branches of labor and social legislation. Within the last 8 or 10 years there has taken place a very marked development in the attitude of all Europe to this question of compulsion in social insurance. So many compulsory insurance systems against sickness, old age, employment, etc., were passed between 1909 and 1914, (when the European War put a temporary halt to all constructive social legislation), that it is highly inaccurate to describe the compulsory method as a Germanic method. Compulsory compensation for industrial accidents is fairly universal in Europe, compulsory health insurance is found in 10 countries, while voluntary subsidized insurance exists in four. France and Sweden have followed Germany's example in establishing compulsory old age insurance. Great Britain marked a very important step in 1911 by establishing at once systems of compulsory insurance against sickness, invalidity and unemployment. In many countries without a general compulsory system, partial systems for certain industries exist, and in several others many steps have been taken for an establishment of compulsory systems, and these were only postponed through the action of the war. Social insurance legislation was perhaps the most important topic of legislation in Europe during the last decade. The entire modern social insurance movement proceeds from the theory that not only is the individual wageworker unable to meet the hazards that face him, or the cost of insurance against them, but that also holds true of the wageworkers as a group. Financial assistance is, therefore a very essential principle of social insurance. In regard to industrial accidents the principle is fairly generally recognized that they constitute a proper charge upon industry, and with a few minor exceptions, industry through the employer is made to bear the entire cost. That is also true of occupational diseases wherever they are specifically provided for. Health (or sickness) insurance has developed upon a basis of joint contribution of employers and employees in proportions varying in different countries. The more recent enactment added, however the principle of state subsidies so that in the Acts of Norway, Great Britain and some others, the cost is divided between employer and employee and the state. In invalidity and old age insurance this method of contributions from three sources has been recognized in the beginning and gradually the advantage of distributing the cost between employer, employee and the state (or in some cases the local geographic and administrative unit) are gaining the position of a general social insurance standard.

In favor of such a method the advantages of a wider distribution of the cost are emphasized. It is argued by some students that the same advantages can be achieved in a very much simpler way by putting the total cost at once upon the state. This has expressed itself in the old age pension systems of Great Britain, Denmark, France and some Australian countries, in a few maternity pension acts and some 20 mothers' pension acts in the United States. Further extension of this method of gratuitous pensions, at least in some branches, does not appear impossible.

Development in United States.— Interest in social insurance problems in the United States is very recent, and scarcely extends over six or seven years, though of mutual efforts toward insurance of workmen there have been many. Trade unions, fraternal societies, large employing corporations, railroads, municipalities and some other political entities have tried to build up some systems of insurance protection of wageworkers. In a legislative way the problem began to attract attention only toward the close of the first decade of the 20th century, when the movement of compensation legislation spread throughout the country. Though the early acts were declared unconstitutional in 1911 and 1916, 32 States passed accident compensation acts, and compensation is almost universal outside of the black belt. Almost simultaneously with that, from 1913 a very active agitation for mothers' pensions developed which proved successful in more than 20 States. Old age insurance and pensions have been discussed for some years, and were made the subject of several State investigations with occasional endorsements of the underlying principles, but as yet without any specific recommendation for immediate action. The unemployment situation of the years 1913 and 1914, especially coming after the establishment of the compulsory unemployment insurance system of Great Britain, has stimulated interest in this most difficult branch of social insurance. But the strongest recent development has been in the direction of social health insurance. In 1915 an investigating social insurance commission was provided for in California, and in 1916 in Massachusetts, both specializing in the problem of health insurance. The American Association for Labor Legislation has a standing committee on social insurance since 1912, devoting most of its work to health insurance. The first National Conferences on Social Insurance were held in Chicago in June 1913, and the second one under the auspices of the United States government in December 1916. The California commission in its report recommended health insurance legislation as the most practical solution of pressing social problems after workmen's compensation. It advised the adoption of the compulsory system. Because of the probability of a law of this kind being declared unconstitutional by the State courts, a constitutional amendment was submitted to the voters in 1918, and meeting with violent opposition from the Christian Scientists and from the commercial insurance companies, was rejected. Up to the beginning of 1919 Massachusetts was the only State which provided vocational training for industrial cripples as part of its compensation scheme. Eight State legislative commissions were investigating the subject of health insurance in the winter of 1918–19. Organized labor was pressing more insistently for the enactment of compulsory health legislation. The New York State Federation of Labor placed health insurance first among its demands on legislative candidates in 1918. Despite this a reactionary legislature in the 1919 session defeated all efforts to enact health insurance legislation in New York. Members of the medical profession were opposed to such legislation. The Massachusetts commission reported in favor of «sickness prevention» in 1918, but made no very definite recommendations as to methods. Among the States which have appointed commissions to investigate social insurance problems are Connecticut, Illinois, Ohio, New Hampshire, Pennsylvania and Wisconsin. Compensation and insurance for soldiers and sailors and allowances for their dependents were provided by Federal enactment in 1917. At the close of hostilities in November the government reported that nearly $37,000,000,000 had been taken out in life insurance by our over 4,000,000 men of the army and navy; this was the greatest insurance, for such it is, that the world has witnessed hitherto, since the total amount of life insurance carried by commercial and other companies is estimated to be $3,000,000,000 less than this amount. It is generally admitted that health insurance of a compulsory character will be the logical development from compensation legislation.

The effect of social insurance upon the well-being of the working masses is recognized by students of economic conditions with hardly any exceptions. There are probably some 60,000,000 in Europe who with their dependents enjoy some one or more forms of social insurance protection. The financial operations of the social insurance systems annually measure many hundreds of millions of dollars, which go to relieve destitution and suffering among wageworkers, either in form of pecuniary benefits or medical or similar curative care. A substantial proportion, probably more than one-half of that amount, is contributed by the employers and the State in virtue of the law. But it is frequently pointed out that of more importance than the mere relief of existing distress is the preventive effect. Accident compensation proved to be an important factor in accident prevention, health and invalidity insurance though a better form of organization of medical, surgical and hospital aid is recognized as a powerful factor for general conservation of life and health. Maternity insurance is advocated because of its effect upon the health of mothers, and also as an additional force in the struggle against excessive infant mortality, unemployment insurance to exercise a salutary effect in prevention of excessive depressions, because it preserves to some extent the purchasing powers of the unemployed wageworkers.

As against these advantageous effects, social insurance is being frequently charged with providing a stimulus to malingering. That a certain amount of such malingering develops under social insurance as well as under any other form of insurance is usually admitted, but it is claimed that this evil tendency may be kept in check by appropriate administrative care, and that it is more than counterbalanced by the salutary results upon the health and happiness of the working class. It is admitted that in no country has social insurance as yet entirely abolished pauperism and destitution, because in no country has this method been developed to its highest capacity, and also because there exists certain factors of destitution not amenable to the social insurance method, but the rapid extension of this method from one country to another is pointed to as a sufficient argument in favor of the advantages to be derived by the entire country by this method.

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SOCIAL LEGISLATION, a general term covering laws enacted for the control of social problems arising through modern conditions of vast industrial enterprises and the changed mode of living arising therefrom. Among them are those governing old age pensions, social insurance, workmen's insurance, child labor laws, etc. See Social Insurance, etc.

SOCIAL PSYCHOLOGY. Social psychology is that branch of psychology which deals with the mind as it is affected by and manifested in relations with other minds. It deals with the behavior of human beings and animals in groups, and the emotions and thoughts which group behavior involves. There is a tendency on the part of certain writers to regard it as the psychology of the group mind or of group behavior, while others would emphasize rather the individual in the group and consider it as dealing with the behavior and experience of individuals when they form part of groups. The former hold that the mind of a group of individuals is a real being; something more than the aggregate of the individual minds which compose it. In this article we shall take the position of the latter, that all psychology deals with individuals and that social psychology deals with them in their relations to one another.

Social behavior is manifested throughout the animal kingdom (1) in the form of special responses to living, that is, moving, stimuli; (2) in that of special responses to individuals belonging to the same species, in the tendency to form collections of individuals, to respond with aid to sounds of alarm, to imitate the sounds and movements of other animals, and even, in the case of ants and bees, to assume certain special functions in the service of the social group. Certain individual bees, for instance, take upon themselves the work of ventilating the hive by placing themselves near its mouth and rapidly moving their wings. Social behavior is manifested also (3) in the sex reactions of animals, both those connected with mating itself and those concerned in guiding the sexes to each other, through the senses of smell, hearing and sight. It is manifested (4) in parental behavior, where the movements of the parents are adapted to secure the welfare of offspring. From our animal ancestors we inherit all these forms of social behavior as innate tendencies or instincts. Excellent discussions of social instincts may be found in McDougall's 'Social Psychology' and Shand's 'The Foundations of Character.'

The social instincts of man, however, differ from those of the lower animals in being accompanied by imaginative sympathy. The social behavior of animals shows features which indicate that it is not accompanied by any realization of the mental state of others. For instance, an adult wasp engaged in feeding the young, lacking other food to present to a larva, bit off a piece of the larva itself and offered it as food to the larva's mouth. The social behavior of animals is determined wholly by external stimuli and by the animal's physiological state; that of human beings is determined largely by these, but also by the imaginative interpretation of other persons' minds. Thus animals imitate merely the movements of other animals; human beings imitate the mental states of others.

Derived from such animal instincts as the gregarious instinct, the imitative instinct, the fighting instinct, the self-exhibiting instinct, the sex and parental instincts, we have the social emotions, anger, jealously, sex and parental love, and the sentiments such as admiration, contempt, agreement, vanity and so on. It is possible also to trace the moral sentiments and the religious sentiments to innate roots which are derived from the lower animals. Thus social psychology furnishes the scientific basis of ethics.

The instinct of imitation has been given especial prominence by social psychologists. The French sociologist Gabriel Tarde, in his works, 'Les lois de l'imitation' and 'La logique sociale,' regarded imitation as the most fundamental phenomenon in sociology. He defined a society as a group of persons who imitate each other, and pointed out that, like undulation in the physical world and heredity in the world of life, imitative currents in society spread in geometrical proportion, are modified by the medium through which they pass and interfere with each other. Out of the interferences of imitative currents inventions arise. E. A. Ross' 'Social Psychology' is based largely on Tarde's teachings. Recently the tendency has been to lay less emphasis upon imitation, but it seems clear that only through imitating other persons are we enabled to understand their mental states and that an innate tendency to imitate is the root of that imaginative sympathy which accompanies social behavior in man.

Another instinct which is of especial importance to the social psychologist is, obviously, the gregarious instinct. The different types of social groups formed by human beings are especially interesting to those who regard the mind of a group as an independent entity. We may distinguish groups linked by the sex and parental instincts, i.e., families; groups linked by economic necessity, by a common aim, such as philanthropy or religion, by likeness of external circumstances or situation, and so on. Each type of group has its peculiar features and the mind of an individual differs according to which type of group he is related to at a given time. It is interesting also to study the mental differences between groups, such as the races and the sexes, separated by congenital unlikenesses.

An innate tendency of the first significance to social psychology is suggestibility. It is really the tendency which we all have to carry out ideas into action, but the term usually indicates this tendency in the case where the ideas are recognized as coming from some other mind. The strongest influence which opposes suggestibility is the fighting instinct, inherited from the lower animals. Individuals vary greatly in the degree of their suggestibility; some persons balk at every suggestion coming from others, even though it be in the line of their own desires, while others are at the mercy of the last person who advises them. Measurement of the suggestibility of a given individual is a task of much practical value in diagnosis. It has been attempted by the method of showing pictures and then questioning the individual about what he has seen. A certain number of the questions relate to details which were not really present in the picture, and the number of such suggestions that the person accepts is regarded as indicating the degree of his suggestibility. Binet, in his 'La suggestibilité,' developed a number of other simple methods of testing suggestibility, especially in children. Every normal person tends to resist suggestions to a certain degree. Thus Sidis, in his 'Psychology of Suggestion,' states as the law of normal suggestibility that it varies inversely with the directness of the suggestion; direct suggestions tend to excite the fighting instinct. In certain cases, however, even a normal person will accept direct suggestions. The most important conditions of such acceptance are the prestige of the suggestor and repetition of the suggestion. Indirect suggestions are suggestions given in such a way that they do not obviously come from another mind; they seem to proceed from the individual's own thoughts or from the surroundings. The whole problem of securing the acceptance of suggestions is probably the most practically important part of social psychology. It confronts the advertiser, the salesman, the educator, the religious and the political leader. The psychology of advertising, for instance, is now a distinct branch of research to which the business world is lending strong financial support and from which it is getting valuable returns.

Under certain conditions suggestibility becomes abnormal in degree, that is, the fighting instinct ceases to oppose it. This usually occurs when the field of consciousness is narrowed, so that the criticism which a suggestion ordinarily encounters in the mind of the person to whom it is made is lacking. The suggested idea takes entire possession of the attention, and no reasons for opposing it are considered. Such a narrowing of the field of consciousness, called dissociation, occurs in hysterical states, in strong emotions and in the hypnotic trance. Persons thus abnormally suggestible may be dangerous to the community. The existence of abnormal suggestibility thus is a fact of which the criminal law must take cognizance. It is probable, however, that no person otherwise thoroughly normal can be hypnotized into the performance of an act of crime. Abnormally suggestible persons are likely to be mentally defective; although Breuer claims that the hysterical temperament is found in persons of the highest intellect and character. Goddard, in 'The Criminal Imbecile,' records a case of murder apparently due to the abnormal suggestibility of a feeble-minded person in the hands of another individual.

Abnormal suggestibility is interestingly manifested, even by normal persons, in a psychological crowd. A mere aggregate of individuals, however closely crowded physically, does not constitute a psychological crowd. The individuals must have their attention fixed on a common object. As soon as a number of persons concentrate their attention in the same direction, they tend to become abnormally suggestible. This is due largely to the loss of the normal sense of the criticism of others. A considerable portion of the criticism with which a person in the normal state opposes a suggestion is derived from his thought of what persons other than the suggestor may think of his conduct. The feeling that others are with us, as in a psychological crowd, obliterates this criticism; thus persons in a crowd do what they would never do as isolated individuals. Since the emotions are the experiences which all mankind has in common, while ideas vary greatly from one person to another, an aggregate of persons becomes unified into a psychological crowd more quickly under the influence of emotions than under that of ideas. The crowd has the characteristics common to all humanity and often displays instincts which are in the normal individual suppressed; it is incapable of real thought. Since most persons enjoy emotions and dislike to think, most persons enjoy entering into psychological crowds. LeBon's 'The Crowd' is the classic discussion of the phenomena of crowd psychology.

The phenomena of the religious life offer a fruitful field for the social psychologist. Religion itself, in so far as it concerns the relation of man to a higher personality, is a product of the social instincts, the desire for companionship and protection and is closely related to the gregarious, parental and sex instincts. In the striking phenomena of sudden conversions we have an interesting illustration of the ultimate effect of suggestions which have been resisted. Their effect has nevertheless been registered in the "subconscious" or unconscious regions of the nervous system, and the sudden transformation of the individual's life and ideals is due in all probability to their having accumulated sufficient force to break down the resistance offered to them by processes in the conscious levels of the nervous system. Persons of a hysterical temperament, who are subject to dissociation or splitting of consciousness, are more likely to experience sudden changes of heart and ideals.

Closely related to social psychology, and indeed forming an essential supplement to it, is folk psychology. This is the study of the origins of social phenomena, such as social groups, language, religion and art. These origins must, since they lie in a past long preceding the dawn of history, be studied chiefly through the investigation of the phenomena of savage life.

It is difficult to say how far these really represent primitive levels of culture. In the case of religion, the remarkable longevity of religious rites enables us to trace certain religious ideas back into prehistoric times. The facts point toward the existence, as the earliest known germ of religion, of a prepersonal type of religious attitude, marked by rituals designed to use the supernatural power or virtue, the Mana, in various objects and animals which aroused man's awe; a stage of totemism which preceded belief in gods. In the case of art, a study of savage customs strongly suggests that one group of arts is derived from the dance, which with its power of forming psychological crowds is a great factor in the life of primitive peoples. Music, poetry and the drama are all probably indebted to the dance for their origin. The decorative arts can be studied almost from their beginnings through the preservation of buried objects and of drawings on the walls of caves. It is more difficult to trace the early history of language than that of either religion or art, owing to the rapid and complicated processes of change which it undergoes, and to the fact that when in a primitive state it is not written. The reader will find interesting material on folk psychology in Thomas' 'Source Book of Social Origins,' and in Wundt's 'Folk Psychology' (translated by Schaub).

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SOCIAL REFORM PROGRAMS AND MOVEMENTS: Their Historical Development.

I. Introduction.

The programs and movements for social reform date back in their origins almost to the dawn of written history. Oppression of certain classes existed in the first historic societies and it is not surprising that some of the earliest literature reflects the growth of discontent among the subject groups. As Professor Seligman has pointed out, the desire to improve the social environment has ever been the dynamic impulse back of the evolution of economic doctrines, though it is quite true that theories which have once been the harbingers of progress may later be utilized as a bulwark of the existing order. While proposals for the betterment of social conditions have appeared in all ages, they have been most numerous after great social and economic revolutions which have altered the status of existing classes and have brought an abnormal amount of misery to those whose condition was most seriously affected by the transition. The development of Athens into a commercial empire, the growth of the plutocracy in the Roman Republic, the disintegration of Roman society in the 4th and 5th centuries A.D., the breakdown of feudalism and the origin of the national states, the rise of the bourgeoisie following the Commercial Revolution, that greatest of all social and economic revolutions — the Industrial Revolution of the late 18th and 19th centuries — and the growth of modern imperialism with the expansion of European civilization throughout the world are well-known examples of social and economic transformations which have produced their accompanying programs of social reform. Though it might be interesting to deal in some detail with the early social reform movements preceding the Industrial Revolution, the far greater significance of those which have followed it must constitute the reason for devoting the greater portion of this brief survey to a sketch of the more significant social reform movements and programs which have developed since the opening of the 19th century.

II. Social Reform Movements Before the Commercial Revolution.

Though it was not the first social reform program, the earliest scheme for social reconstruction which has remained a classic through the ages was the 'Republic' of Plato. Here was proposed a society resting fundamentally upon a social division of labor, being physically perfected by an elaborate plan of eugenics, and governed by the wisest members of the community. But even Plato recognized the futility of hoping for the adoption of so rational a social system, and it was marred by another serious defect beyond its utopian flavor on account of the fact that it was designed to apply only to the upper classes; the others would, it was hoped, be reduced to a still more severe and permanent state of subjection. The Gracchi brothers made an attempt to check the growing power of the Roman plutocracy, but the vested interests proved too strong for their efforts. The Apostolic Christians, living in the hope of an imminent return of Christ, developed communistic tendencies and doctrines, but the special circumstances under which they were conceived prevented them from having any considerable significance for the history of social reform programs. While the eschatological conception had been somewhat weakened by the time of the later Patristic period, it was still powerful enough to paralyze any social initiative. The faithful were warned against undue concern over earthly conditions, lest they thereby forfeit entry into the kingdom of heaven. The poor were regarded as a part of the divine order who existed for the spiritual edification of the rich alms-givers. The Patristic outlook, coupled with the static nature of the caste system which developed as the social basis of feudalism, and the general backwardness of mediæval civilization made the «Middle Ages» a period designed to discourage any radical movements in social reform. It should not be forgotten, nevertheless, that the more radical religious movements of the mediæval period, associated with the Waldenses, the Albigenses, the Franciscans and the Lollards, carried with them a varying degree of revolt against the social and economic conditions as well as the religious institutions and practices of the time. It is probable that of all the mediæval programs of social reform the most interesting and progressive was that set forth by Pierre Dubois at the opening of the 14th century in his 'De Recuperatione Terre Sancte,' with which Mr. Powicke has familiarized English and American readers. Finally, the discussions of the Conciliar Movement bear, perhaps, some vague relation to the problem of social reform in so far as that is related to the development of representative government.

III. The Commercial Revolution and the Resulting Social Reform Movements.

While, as Professor Shepherd has insisted, there is need of a greater preciseness of definition in dealing with the Commercial Revolution as a phase in modern history, it will suffice for the purposes of this survey to regard it in the conventional manner as the period of discoveries and colonization which began in the late 15th century and lasted for about three centuries in its first phase. With it should be associated its epoch-making reactions upon European civilization in nearly every field. This great transformation brought with it the decline of the feudal order, the rise of the merchant class in the political as well as the economic field and the gradual development of the modern national state, at first purely dynastic but later becoming more and more a representative if not a democratic institution. At first the new merchant class or bourgeoisie supported the kings in their attack upon the feudal nobility, but once the feudal lords had been coerced the middle-class arose against the monarchs and brought them within the restraints of constitutional limitations upon the royal prerogative. The social and economic effects were not less distinctive. The manorial system was undermined or completely shattered; the gild system was weakened or wholly supplanted by the «domestic system»; and the above changes profoundly affected all social classes, working its severest effects upon those whose status was reduced by the transformation. In the intellectual realm the curiosity stimulated by the discoveries led to those great scientific advances in nearly every field for which the 17th century is conspicuous.

The social philosophy which was produced by the Commercial Revolution bore a close relation to the political, social, economic and intellectual setting which was created by it. In the field of political theorizing the royal absolutism was accompanied by the divine-right doctrine, associated with the names of Filmer and others, while the rise of the bourgeoisie against despotism produced as a philosophy of justification the social contract school with their apologies for revolution in the writings of Sydney, Locke, Rousseau and their followers. The social and economic changes, with their accompanying misery to the lower classes, gave rise to the various «utopias» which attempted theoretically to construct ideal societies which would embrace none of the evils of existing conditions. This class of writings was best illustrated from widely differing points of view by Sir Thomas More's 'Utopia,' Francis Bacon's 'New Atlantis,' Tommaso Campanella's 'City of the Sun,' James Harrington's 'Oceana' and François Fénelon's 'Télémaque.' The growth of rationalism was especially significant for the development of social reform programs. While the relationalists were rarely violent political or social revolutionists, nevertheless, as Professor Robinson has made clear, their very scepticism concerning current views on the nature and significance of natural and social phenomena inevitably led to a critical attitude toward social institutions and the gradual development of a «spirit of reform.» Particularly important in this respect were the doctrines of the English Deists and their followers among the French Philosophes. Taking their premises from the laws of mechanics governing the natural universe, which had been discovered by Newton and his predecessors, the Deists insisted that there was a natural order — a régime of natural laws — which governed the social system as well as the natural universe and to which social institutions should conform. They held further, in radical contrast to the depressing theological views of Augustine and Calvin, that man is inherently decent and worthy of study in the effort to improve his earthly environment. This doctrine did more than anything else to remove the obstacles to social self-improvement which were embodied in Augustinian eschatology and the predestinarian anthropology of Calvin, and was very effective in producing the growth of a humanitarian spirit. Strangely enough, however, a part of their cosmic and social philosophy became itself a great barrier to social reform when their notion of the «natural order» was adopted by the adherents of «economic liberalism» to form the metaphysical basis of their defense of *laissez-faire*. Finally, it should be remembered that, in spite of the fact that it was designed wholly in the interests of the upper classes, the extensive legislation involved in Mercantilistic commercial regulations furnished a precedent for widespread state activity which might one day be exerted in the behalf of the proletariat.

The French Revolution has long been regarded as a unique and heroic event in human history, but recent analysis has proved it to be but a final phase of the reactions of the Commercial Revolution upon France. Henry IV, Richelieu and Mazarin, with the aid of the new middle-class, had destroyed the political power of feudalism, but had successfully stifled the growth of representative or democratic institutions in France. The French Revolution marked that stage of development in which the bourgeoisie ended even the economic and social vestiges of feudalism and terminated irresponsible royal despotism. The social revolution achieved by the French between 1789 and 1795 consisted mainly in the despoiling of the feudal landlords and the elevation of the middle or business class. The latter not only attained unto political power, but also secured legislation giving far greater freedom to business enterprise. No other class profited materially from the Revolution, while the nobility and the clergy were greatly reduced in wealth, power and prestige. The programs of social reform put forth during this movement varied all the way from the advocacy of limited constitutional monarchy by Lafayette and Sièyes to the fantastic radicalism of the Mountain and the openly avowed socialistic proposals of François Babœuf, which might be quite properly classed as akin to the utopias of the preceding century. But in spite of some radical programs of social reform and some mob-violence by the proletariat, the lower classes, both agrarian and industrial, failed to profit to any marked degree through the French Revolution, which was above all a bourgeois movement. For the elevation of the proletariat in France, three subsequent revolutions and the growth of modern industrialism were required.

One of the most important and far-reaching effects of the Commercial Revolution upon social history was its preparation of Europe for the more sweeping transformation in the Industrial Revolution. By breaking up the feudal system and agrarian isolation, by stimulating commerce and the growth of capital, by inviting colonial enterprise and the development of foreign trade, and by developing constitutional government to give business liberty and security, the Commercial Revolution paved the way for the coming of the Industrial Revolution. That the latter came first in England is to be explained by the fact that England had participated most extensively in the Commercial Revolution, that her industries and natural resources were best adapted to the adoption of a mechanical system of manufacturing, and that she had developed to the greatest degree of any country in Europe that constitutional and legal protection to industrial and commercial enterprise which was indispensable to any extensive expansion of business.

IV. The Industrial Revolution and the Social Problems It Created.

It will be quite impossible in the space available to describe the mechanical inventions which constituted the material basis of the Industrial Revolution or even to enumerate all of its diverse results. For this the reader must be referred to the preceding article in this Encyclopedia by Prof. E. L. Bogart on the INDUSTRIAL REVOLUTION. It will suffice at this place to describe it as that great economic transformation which introduced the mechanical era of manufacturing and the improved motive power for transportation and the communication of intelligence, together with the great social, political and intellectual changes which accompanied the economic transition. The effects of the Industrial Revolution amount in their totality to modern civilization, but only a few of the more generally recognized results can be mentioned here. Through the introduction of machinery, the minute division of labor and the specialization of industrial processes there resulted a vast increase in the volume of commodities produced for sale and a great consequent expansion of commerce, leading to that search for new markets which constitutes the connecting link between the Industrial Revolution and the development of modern national imperialism. The factory system necessitated the congregation of workmen into the new industrial cities which now sprang up for the first time and supplanted the agrarian age. The bourgeoisie were greatly increased in numbers and wealth, and evolved into a distinct capitalistic class. A sharp distinction now arose between capitalist and laborer, and social and economic relationships passed, as Professor Burgess has pointed out, from a personal to an impersonal basis. The laborer became progressively more and more dependent upon the capitalist and the problem of unemployment became much more serious. Women and children were introduced as laborers in the new factories to their moral degradation and physical deterioration. The division of industrial processes into minute stages made it impossible for the workman to complete the manufacture of any commodity and thereby lessened his interest in its production and created a psychological burden which had hitherto been foreign to industrial processes. The machine technology, as Professor Veblen has explained, brought a psychic and cultural standardization correlated with the mechanical processes of the new order. In the large, however, the Industrial Revolution meant, as Professor Shotwell has insisted, a transition from an agrarian civilization based on isolation, repetition and stability to the modern order founded upon a dynamic industrialism and the development of world-wide relationships. It has constituted far the greatest transformation in the history of humanity and has produced at least a material progress more notable than the race had yet achieved from its beginnings down to the close of the 18th century.

It was inevitable that so fundamental and sweeping a transformation as this should bring great hardship upon those who suffered most from the transition. Had the proletariat been able to support itself by handicraft trades and by petty agricultural operations their lot would not have been so hard, but at the very time when the mechanical inventions were making handicraft competition impossible an agrarian revolution was taking place in England which ousted the peasantry from their agrarian holdings. The new merchant princes, desirous of attaining the social prestige of the ancient landed nobility and encouraged by the new agricultural methods which had been introduced by Tull, Townshend and Bakewell, proceeded in the period from 1760 to 1840 to buy up most of the land of England for great estates. The peasantry were bought out or evicted and were compelled to take refuge in the new industrial cities, where they became the helpless victims of the avarice and greed of the parvenu capitalist manufacturer. Those who remained in the country and tried to compete with mechanical industry or large-scale agriculture met a fate not less severe than that of those who migrated to the cities. In the cities the great surplus of laborers made wages low and unemployment frequent. The possibility of utilizing the labor of women and children reduced the wages paid to adult males or led to their discharge. All — men, women and children — worked at monotonous labor during excessively long days for starvation wages in dangerous and unsanitary shops amid moral conditions even more deplorable. At night they were herded into cheaply built tenements even less healthy than the shops. As one writer has expressed it, they «lived the life of a machine while working and at other times that of a beast.» The chimneys of factories and dwellings were swept by very small children under conditions which meant the permanent distortion and dwarfing of their bodies and serious diseases of the respiratory tract, if they were not fortunate enough to meet an early death. In the mines conditions were, if anything, worse than in the factories. Women and small children, as well as men, worked in damp and dark underground passages amid vermin and filth for long hours at a stretch at the most severe type of physical labor for a pittance. Whatever one may think of their remedies, there is no doubt that the socialistic analysts of these conditions, such as Marx and Engels, have drawn an accurate picture of the horrors of the social conditions during the first stages of the Industrial Revolution. It would scarcely be possible to exaggerate them. One must not, however, forget to give due recognition to these early capitalists for their part in building up the industrial civilization of the modern age, probably the greatest achievement of human genius, even though it threatens at times to develop into a Frankenstein. Further, it is not necessary to assume that all of these early capitalists were fiends to allow such conditions to exist among the working classes. They were usually in little personal contact with conditions and the old business ethics that had governed the gild and domestic systems were wholly inadequate for the new circumstances, while no new system of industrial morality had yet evolved. Nevertheless, it must be remembered that the conditions in the business establishments in the early stages of modern industrialism resembled what Hobbes imagined the life of man in the state of nature to be, and it is, therefore, not surprising that these evils produced a literature of protest and reform which was unprecedented in volume and variety.

The proletariat found it impossible to help themselves out of the serious oppression to which they had succumbed. In no important country in Europe did they exercise the right of suffrage permanently before 1848, and they played an insignificant part in politics until the last quarter of the 19th century. Labor organizations were forbidden entirely or penalized by unfavorable legislation. Violent opposition to the existing order was made well-nigh impossible by the savage criminal codes of the time which reached their worst form in England where nearly 300 capital crimes were enumerated. Any far-sighted program of self-improvement by the laboring classes through education and enlightenment was impossible of realization, for no comprehensive system of free public education existed in Europe except in Prussia, which was not vitally affected by the Industrial Revolution until the decade following 1870.

V. Immediate Remedies Proposed by Contemporaries to Solve the Social Problems Created by the Industrial Revolution.

1. Economic Liberalism.— The first great type of reform proposed to meet the new conditions was that which has been designated by recent economic historians as «economic liberalism,» but which is more generally known as the economic doctrine of *laissez-faire,* or the political theory of individualism. This body of doctrine cannot be properly appraised unless the historical circumstances surrounding its origin and diffusion are taken into consideration. It began before the Industrial Revolution as an attack upon the archaic legislative restrictions which had grown up as a part of the Mercantilistic commercial and colonial doctrine, and, in so far as it helped to clear away these obstructions, it contributed to the coming of modern industrial society. After the Industrial Revolution had come, however, its later adherents utilized the *laissez-faire* concepts to defend the new capitalistic order and to prevent, as far as possible, the solution of the grave evils it created through remedial legislation.

The founders of economic liberalism were the group of French writers in the middle of the 18th century, known as the *Physiocrats* from the work of one of their adherents, Pierre Samuel Dupont de Nemours, entitled ‹Physiocracy, or the Natural Constitution of that Form of Government most Advantageous to the Human Race› (1767). They took their basic doctrine from the English Deists and the French Philosophes to the effect that the realm of social, political and economic phenomena was governed by the same natural laws that Newton and his associates had shown to rule the physical universe. They believed that the perfection of all human social institutions could best be realized by making them conform to this natural order, a condition which would most certainly be produced by a régime of unlimited competition. Accordingly, they vigorously advocated the immediate and total abolition of all restrictive legislation and the introduction of an era of *laissez-faire* individualism. The chief functions of the state were to be the protection of life and property, the erection of public buildings and works, and the promotion of education, so that man might grasp more surely the principles of natural law. Extensive legislation was regarded as dangerous, for it would probably impede the operation of those beneficent natural principles upon which they placed their chief reliance. The Physiocrats contributed views of less significance in their interpretation of social progress in terms of the net product of agriculture and their scheme of a reform in public finance which centered about the notion of a single tax on land. The moving genius among the Physiocrats was François Quesnay (1694–1774), who was ably seconded by Gournay, Mirabeau, Dupont de Nemours, Mercier de la Rivière, Badeau and La Trosne.

The general notions of the Physiocrats concerning individualism and state inactivity, except in the field of abolishing restrictive legislation, received the support of the distinguished French economist and statesman, Anne Robert Jacques Turgot (1727–81) and of the first great systematic writer on political economy, the Scotchman, Adam Smith (1723–90). The chief significance of Adam Smith for the history of social reform is that he embodied the *laissez-faire* thesis in a notable work, ‹An Inquiry into the Nature and Causes of the Wealth of Nations› (1776), which received so wide a circulation and attracted so extensive a following for Smith's doctrines that the historian Buckle, nearly a century later, regarded this book as the most influential and beneficial one ever written. Aside from his acceptance of the general Physiocratic position on the proper functions of the state, Smith abandoned to a considerable degree the excessive Physiocratic laudation of agriculture and emphasized the value of commerce and manufacturing industry. Especially did he revive the Platonic doctrine of the importance of the division of labor in increasing and improving productivity, and his emphasis upon the part played by labor in production paved the way for the later views of Ricardo and the Socialists respecting the «labor theory of value.»

Smith, however, died before the Industrial Revolution had fully developed even in England, and there is good evidence for holding that he did not even foresee the course of this transformation, much less stand out as an apologist of the new capitalist class. But his doctrines were of a sort which fitted in admirably with the policy of non-interference which the capitalist manufacturers desired to have prevail, in order that they, if not their employees, might enjoy the "blessings of the perfect freedom of contract." Therefore, his notions were expanded and utilized by the middle class and sympathetic economists to furnish an authoritative theoretical opposition to social legislation designed to advance the interests of the industrial proletariat.

The most extensive development of his concepts naturally took place in England where he had written and where that industrialism which was most congenial to his views was the furthest advanced, but he was honored by reverent disciples in every important European state and in the United States. His most distinguished English disciples were Thomas Robert Malthus (1766–1834); David Ricardo (1772–1823); James Mill (1773–1836); John Ramsay McCulloch (1789–1864), and William Nassau Senior (1790–1864). The one thing which, in particular, distinguished the doctrines of Smith from those of his disciples was his greater optimism, a difference which may be explained by the great change in the economic environment in the interval which had elapsed. While the central importance of these writers was their elaboration of the individualistic hypothesis, each contributed some special interpretation of more or less originality and significance. Malthus held that remedial legislation was not only harmful as interfering with the natural order of things, but was also useless as far as any hope of improving the poorer classes was concerned. He maintained that even though distribution were equalized no permanent good could result, because population tends to increase more rapidly than the means of subsistence, and this disparity between population and available means of support would ultimately be restored and with it would come a return of poverty and misery. Through an excessive birthrate the proletariat created its own misery, and the only hope of permanent relief lay in the artificial control and restriction of the birthrate through the postponement of marriage. Ricardo paid particular attention to the subject of distribution. From the Physiocratic notion that the wages of agricultural laborers tend toward the minimum of subsistence and Malthus' doctrine of population he derived his famous "subsistence theory of wages." According to this theory wages tend to that level which allows the laboring class to exist and perpetuate itself without either increase or decrease; hence the folly of legislation designed to enlarge the income of the proletariat, for the resulting increase of population would prevent any diminution of poverty and misery. Further, Ricardo attacked the landlords by maintaining that rent tended to absorb an ever greater share of the social income, and that their interests were opposed to those of all other economic classes. Finally, he laid the basis for the Marxian theory of value by holding that, within certain definite limitations, value is determined by the amount of labor involved in production. James Mill brought into economic liberalism the utilitarian philosophy of Bentham regarding the maximum good for the largest number, which Mill and his associates confidently believed to be attainable through the operation of the principles of economic liberalism. McCulloch was chiefly a systematizer of the principles of his school and was the most sympathetic member of the group toward the laboring classes, being a supporter of Place and Hume in the attempt to legalize trade-unionism. Senior represented the final and most extreme stage of economic liberalism through his attempt to perfect economics as a purely abstract and objective science and by his ardent opposition to even the mildest form of legislation beneficial to the laboring classes. While most of these writers took little active part in politics, their ideal "of perfect competition for the employers and subjection for the workers" was eagerly adopted by Cobden, Bright and other members of the "Manchester School" and the Liberal party in their effort to reduce the power and privileges of the landed aristocracy and to enforce and perpetuate the servile and helpless status of the laborers. Further, their notions were widely popularized, and their general views were as much the order of polite conversation in British parlors as the Rousseauean notions of the state of nature had been in the French salons of a half century before.

In France the doctrines of the later version of economic liberalism were espoused by a number of economists, the most notable of whom were Jean Baptiste Say (1767–1832) and Fréderic Bastiat (1801–50). Say's position was very similar to that of Senior. He maintained that political economy was purely a descriptive science and not in any way a practical art. The economist should simply study and formulate economic laws and should never usurp the functions of the statesman. Reversing the position of the Physiocrats, he laid greatest stress upon the productivity of manufacturing, and he was the most enthusiastic of all the eulogists of the new era of mechanical industry. He was the French bourgeois economist of the period as Guizot was the statesman of this group. Bastiat revived the optimism of Adam Smith and, as an ardent admirer of Cobden, devoted his attention chiefly to an advocacy of free trade. The function of the state, he held, was solely to maintain "order, security and justice." So obsessed were Say and Bastiat over the importance of the manufacturing and commercial classes that many of their less scientific followers came to deny that poverty or misery existed.

In Germany economic liberalism was defended by Johann Heinrich von Thünen (1783–1850) and Karl Heinrich Rau (1792–1870), while in America Henry C. Carey (1793–1879) first introduced the classical political economy, though he differed from Smith's later supporters by reviving the optimism of Smith and attacking the pessimism of Malthus. Moreover, he advocated national protectionism in contrast to the free trade doctrines of the others of the school.

Though it will be evident that economic liberalism was as distinctly a capitalistic movement as socialism has been a proletarian agitation — that, as Cliffe Leslie expressed it, "they created a science for wealth rather than a science of wealth"— nevertheless it cannot be denied that their efforts accomplished much that was good. Before rational state-activity to solve the problems created by the Industrial Revolution could begin in an effective manner it was necessary that the antique rubbish of Mercantilism should be cleared away and this was the great contribution of the economic liberals and their political adherents, even though they offset much of the value of their destructive efforts by obstruction of subsequent progressive legislation. It should also be pointed out in passing that the economic liberals were aided by the contemporary philosophy of Romanticism, with its denial of the possibility of artificially accelerating the rate of political progress, and by the political individualism which had been set forth by Wilhelm von Humboldt, and was later taken by John Stuart Mill in his earlier days and by Herbert Spencer. In England the more notable practical effects of economic liberalism were the growth of free trade, associated with the work of Huskisson, Cobden, Bright, Peel and Gladstone; the abolition of such archaic political restrictions as the Test and Corporation Acts; the increase of the political powers of the middle class in the central and local government by the reform bills of 1832 and 1835; the abolition of slavery in the colonies through the efforts of Wilberforce and Buxton; the repeal of the savage criminal code as a result of the work of Romilly, Mackintosh, Buxton and Peel; the development of a policy of preventive treatment in the handling of the problem of poor relief which was evident in the notable Poor Law of 1834; and the first anticipation of a more liberal policy of imperial government through the leadership of Lord Durham and others. In France serfdom and the gild monopolies were abolished before the close of the 18th century; Guizot directed the Orleanist régime solely in the interests of the capitalists; and Bastiat's doctrines were able to win Napoleon III for free trade. In Prussia, Stein and Hardenburg were able to secure legislation looking toward the complete abolition of serfdom and gild monopolies and the development of municipal self-government. Following 1819 a more liberal economic and commercial policy was embodied in the famous *Zollverein,* the work of Maassen, Bülow, Eichhorn and Von Motz. Most of the other German states followed Prussia in this liberalizing policy, and some, like Baden, quite outdistanced her in this respect. It will be apparent, however, that none of this legislation materially benefited the proletariat. Indeed, some of the legislation of this period was specifically designed to paralyze all efforts of the laborers at self-improvement and the agitators for the abolition of negro slavery in the colonies passed by unnoticed a far worse type of slavery which existed at home among their own countrymen. Such a body of doctrine could not endure long unchallenged in the face of the growth of modern industrialism and the increasing misery of the proletariat.

2. English Philosophical Radicalism and Utilitarianism.— Utilitarianism, a term used by Jeremy Bentham and given currency by John Stuart Mill, is the designation usually applied to the school of writers headed by Bentham (1748–1832) and including, among others, James Mill, George Grote, John Austin, Alexander Bain and John Stuart Mill. They represented primarily the spirit and tenets of economic liberalism in the field of political theory, and their work constituted the only significant contribution of England to this field between the time of Burke and that of Spencer. Essentially, they were a further development of that philosophical radicalism in England which grew out of English sympathy with the French Revolution, and was represented by William Godwin, Thomas Paine, William Cobbert, Francis Place and that group of literary men, such as Shelly, Byron and Wordsworth, with whose works and ideas Mr. Brailsford has recently made English readers familiar. This group stood in direct opposition to the satisfaction which Blackstone and Burke expressed over the alleged perfection of British institutions and maintained the necessity of radical changes in the direction of eliminating archaic laws, institutions and practices. In his earlier years Bentham might have been logically classed with this group, for his first notable work —'A Fragment on Government' (1776) — was a violent attack upon the complacency of Blackstone. But he gradually developed a general philosophy of reform and thus remolded radicalism into utilitarianism. His doctrines were based upon the hedonistic psychology, which had been anticipated by Machiavelli, Hobbes and Helvetius, and upon the ethical slogan of «the greatest happiness for the greatest number»— a principle earlier enunciated but not greatly developed by Hutcheson, Beccaria and Priestley. Institutions were to be judged according to their contributions to the attainments of this «greatest happiness.» His practical program of reform, however, indicated that, like the economic liberals, he regarded unrestricted competition and enlightened self-interest as the chief avenues through which his utilitarian program could be realized. His chief concern was with the abolition of restrictive legislation, but he did urge some positive reforms, such as education of the masses, the extension of savings institutions, public health legislation and prison reform. Further, though Bentham and his immediate followers might seem to have regarded the «greatest good to the greatest number» as best attainable through conferring «the greatest amount of goods upon the business classes,» his terminology was one which, if honestly interpreted, was excellently adapted to serving as a basis for urging a large amount of positive remedial legislation in the behalf of the proletariat. In this way the utilitarian premises later became an important force supporting constructive social legislation. In fact, this evolution of utilitarianism is evident even within the circle of its own adherents, for John Stuart Mill eventually evolved from an exponent of marked individualism into a vigorous exponent of social legislation in the interest of the laboring classes and a not unappreciative student of distinctly socialistic proposals. Probably the only important achievement of this group in the way of aiding the lower classes was the work of Francis Place and Joseph Hume in securing the temporary legalization of trade-unionism, but they made important contributions to securing that abolition of obstructive legislation which was described above in connection with the practical results of economic liberalism.

3. **The Rise of Distinct Forms of Opposition to the Individualism of Economic Liberalism.**—A. *The Criticism of Economists.*—There were a number of theoretical difficulties in economic liberalism which would naturally attract the opposition of political economists. While Smith had actually assumed to be more concerned with the wealth of a "nation" than of a class, it is, nevertheless, true that his followers seemed to be chiefly concerned with the wealth of the new business class rather than with the problem of increasing the prosperity of the entire nation. This brought upon the school the criticism of economists who presented a national or social theory of wealth and maintained that the increase of the wealth of individuals or classes was no safe criterion for judging of the value of an economic, social or political policy to the state or society. This was the point of view especially of the Englishman, Lord Lauderdale (1759–1839), and the Scotch-Canadian, John Rae (1786–1873). The position of the economic liberals generally and of Senior and Say, in particular, that the economist must maintain his science as a purely abstract and descriptive discipline and severely refrain from advocating any policy of statesmanship or social reform was vigorously attacked by Jean Charles Leonard de Sismondi (1773–1842), an itinerant Swiss scholar. He was the most distinguished and effective exponent in his age of the notion that economics has a distinct function in promoting general prosperity and social reform, a point of view since urged with vigor by economists like Schmoller, Gide, Webb, Hobson, Fisher, Fetter and Seager. He saw clearly that economics should be intimately concerned with the problems of practical statesmanship and applied sociology and, more than any other writer of his time, he foreshadowed modern social economics. Moreover, his practical program of reform embraced most of what is now included in trade-unionism, factory legislation and social insurance. He was a solitary figure in his age, but his doctrines were later accorded respect, as economics swung back more and more to the social point of view. Again, the economic liberals were internationalists and exponents of free trade. This attitude was attacked by the early nationalistic economists, Adam Heinrich Müller (1779–1829), Frederick List (1789–1846) and Henry C. Carey (1793–1879). They defended the policy of a national protective tariff to give national self-sufficiency and prosperity. The nation, rather than individuals, classes or human society as a whole, received their special solicitude. They were not, however, inflexibly dogmatic in this position and List, in particular, held that after the Industrial Revolution had become thoroughly established in a country free trade might be beneficial, but to protect infant industries in the first stages of industrial development a protective tariff was indispensable. Finally, the economic liberals erred in the direction of too great an abstraction and absolutism in economic doctrines. They generalized too much from contemporary conditions and were confident in the universal and eternal applicability of their economic laws and theories. This defect was corrected by the early representatives of the historical school of economics, chiefly Richard Jones (1790–1855), Bruno Hildebrand (1812–78), Wilhelm Roscher (1817–94), and Karl Knies (1821–98). The predominance of the Germans in this group has led to the practical identification of the historical school with German economists. These writers ridiculed the element of absolutism in the classical economic doctrines and maintained that any set of economic theory could be true only for the society from which the facts or premises were drawn. Therefore, economic theories must change with historical alterations in the economic constitution of societies, and there can be no invariable economic laws nor any valid economic theory which ignores the dynamic element of economic progress.

B. Political Opposition and Humanitarianism.—It has been shown that economic liberalism was primarily an economic philosophy and a political program designed in the interest of the capitalists, who, in politics, adhered to the Whig or Liberal party. It was but natural, therefore, that it would be assailed by the party whose economic and political interests were diametrically opposed to the business element, namely, the landed proprietors who made up the bulk of the Tory or Conservative party. The Tories had a number of reasons for disliking the capitalists. In the first place, there was the social aversion of the aristocrat for what he regarded as the parvenu eager to break into his ranks. Then they felt that the new industrialism had destroyed forever the "Merrie England" in which the landlords were supreme. Again, they entertained a jealousy of the growing political power of the middle class, especially after the latter had forced through the Reform Bill of 1832. Finally, the economic interests of the two classes were fundamentally opposed; the Tories desired a continuation of the Corn Laws to keep the price of grain high, while the business class desired their abolition to secure cheap wheat and, therefore, according to the current economic reasoning, cheap labor. The Tories were extremely fortunate in finding a point of attack upon the capitalists which enabled them to cloak their political and economic aims under the mantle of humanitarian sentiments and to entertain some hope of increasing their political following among the proletariat. This avenue of assault, decided upon by the Tories, was factory legislation which would reduce the prosperity of the manufacturers by compelling them to grant higher wages or shorter hours and introduce better physical conditions and appliances in their factories. Probably too much has been made of this point by recent writers who have followed Arnold Toynbee in emphasizing the political and economic selfishness that motivated the landlord factory reformers. Doubtless many of the leaders in this movement were governed by real humanitarian impulses, but it can at least be said that they were especially favored in finding a line of social reform which harmonized particularly well with their economic and political interests. The leaders in the earlier stages of this "Tory social reform" were Anthony Ashley Cooper, seventh Earl of Shaftesbury (1801–85), Michael Thomas Sadler (1780–1835), Richard Oastler (1789–1861) and

John Fielden (1784–1849). They secured the appointment of the investigating commissions that have furnished the present generation with most of their sources of information concerning the conditions among the laboring classes in England during the first half of the 19th century and obtained much remedial legislation designed to alleviate or eliminate these conditions. It is impossible in the space available to describe in detail the contents of this legislation, but its general character can be indicated. The factory acts of 1802, 1819, 1831, 1833, 1844, 1847, 1850 and several minor laws of the «sixties» secured for the laboring classes in practically all factories the 10-hour day, proper factory inspection, safety appliances, better sanitary conditions and a general discouragement of child labor. Women and children were excluded from mines, and better hours and safety devices provided for in acts of 1842, 1855 and 1872. The distressing evils in the employment of juvenile chimney-sweeps were eliminated by laws of 1834 and 1840. Particularly the work of Ashley was the important Factory Act of 1833 and the famous «Ten-Hour Bill» of 1847. Thus political jealousy and economic rivalry between the upper and middle classes were able to achieve for the betterment of the proletariat much more than the latter and their sympathizers were able to obtain for themselves. While Shaftesbury may have been motivated by some genuine humanitarian impulses in his campaign for social reform, it is doubtful if the same can be said for the continuator of his policy, Benjamin Disraeli (1804–81), probably the most unscrupulous and self-centred politician in English history. That he thoroughly understood the oppression of the peasantry and the industrial proletariat no reader of his ‹Sybil› can doubt, but little evidence exists that he was touched by any real personal sympathy for the oppressed and much leads one to the conclusion that his advances to the lower classes were founded upon purely partisan and personal motives and ambitions. In part, he continued Shaftesbury's social legislation, but his appeal for the support of the proletariat was primarily political. By the Reform Act of 1867 he extended the suffrage to the greater part of the urban laboring class. This type of social reform again appeared in England during the Conservative-Unionist régime, when it was particularly associated with the name of Joseph Chamberlain. This benevolent paternalism, born of political rivalry, was confined in its earlier stages chiefly to England, for there alone had the new business class attained to sufficient proportions to attract the organized opposition of the landed interests. It appeared at a later time in other European states, most notably in the case of the Bismarckian social insurance legislation.

C. *Early Christian Socialism.*— The new capitalism and industrialism and its theoretical apologists among the economic liberals were undeniably associated with materialism and rationalism and this inevitably led to opposition from the Churchmen and the «faithful» of all types. While programs of social reform hostile to economic liberalism were put forward by Catholics, High Churchmen, Broad Churchmen and Dissenters, one unifying purpose runs through all of their work, namely, the desire to socialize Christianity and thereby to capture social reform for the Church and to attract for religious institutions and practices the increasing gratitude and favor of the numerous members of the proletarian classes.

In the field of Social Catholicism there were a number of interesting developments, particularly in France under the Bourbon restoration and the Orleanist monarchy. The movement began as a revival of emotionalism, obscuranticism and political reaction in the doctrines of François René de Chateaubriand (1768–1848), Louis Gabriel Ambroise de Bonald (1754–1840) and Joseph de Maistre (1753–1821), but the growth of democracy affected Church as well as state in France and the exponents of the religious revival clearly understood that if they were to make any headway they would need to liberalize the Catholic standpoint. This was partially achieved by Antoine Frédéric Ozanam (1813–53), who founded the Society of Saint Vincent de Paul and linked up Neo-Catholicism with practical philanthropy; by Alphonse de Lamartine (1790–1869), who attempted to connect the Catholic movement with the growth of republican sentiment in France; by Robert de Lamennais (1782–1854), who tried ineffectively to harmonize Catholicism and the principles of the French Revolution; and by Philippe Joseph Buchez (1796–1865), who adopted the historical viewpoint of the German school of economists, tried to prove the spirit of Christianity to be revolutionary, anticipated the «gild socialism» of Bishop von Ketteler and Franz Hitze, and advocated a scheme of co-operative production and distribution.

The Protestant members of the first important group of Christian social reformers have usually been those specifically designated as «Christian Socialists,» but there seems no doubt that this title could with equal accuracy be extended to the Catholic reformers. The leaders in this movement were chiefly Anglican clergymen of the Broad Church party, though there was some support accorded by the Unitarians. The most prominent members of the Christian Socialist group in England were John Frederick Denison Maurice (1805–72), Charles Kingsley (1819–75) and Thomas Hughes (1822–96). Others of influence who adhered to their general point of view were John M. F. Ludlow (1821–1911) and John Lalor (1814–56). Maurice, conventionally regarded as the founder of the movement in England, was especially interested in promoting the cause of the education of the laboring class. Kingsley analyzed the social problems of his day in powerful sermons and telling books, like ‹Alton Locke,› ‹Yeast› and ‹Water-Babies.› Like Buchez, he also urged the formation of workingmen's organizations and the institution of co-operative associations. Probably the most enduring contribution of English Christian Socialism to social reform was the impulse which it gave to the organization of co-operative and profit-sharing societies, of which one — the famous Rochedale Pioneers — has endured to the present day. The co-operative movement spread rapidly on the Continent and has developed particularly in Denmark and Belgium. The other important effects of Christian Socialism in this first stage was its aid to the cause of the education of the proletariat and the arousing of the interest of the Anglican Church in social reform. The impulse to social reform within the Anglican Church originated by the Christian Socialists attracted even members of the High Church party, and the leaders of that obscurantic and emotional reaction — the Oxford Movement — such as Whately, Arnold, Froude, Hurrell, Newman, Keble and Pusey lent their support to the development of trade-unionism and the betterment of housing conditions among the poor. Finally, even the dissenting sects, particularly the Quakers and the newer evangelical organizations, as Dr. Faulkner and Miss Simeral have shown, took a very significant part in agitating for remedial legislation for the poorer classes.

D. *The Æsthetic Revolt Against Materialism and Misery.*— While the Industrial Revolution has produced nearly all the material comforts of modern life and created many new forms of art and beauty as well, there can be no doubt that in its first stages, at least, the new industrialism with its dismal factories, clouds of smoke and filthy tenements was extremely ugly and repulsive to the æsthetic temperament and to humanitarian impulses. Therefore, the new order of things and its supporters among the economic liberals received a vigorous attack from those who were the representatives of the literary and artistic standards of the age. This so-called æsthetic revolt against the origins of the modern industrial order was of a rather varied sort, ranging all the way from the purely cultural protest of men like Matthew Arnold to the conversion of leading literary figures like George Sand and William Morris to open socialistic programs. While most of the leading figures in art and literature during the second third of the 19th century were repulsed by the new industrial developments, a few can be singled out as the leaders in the æsthetic protest. Among these were Robert Southey (1774–1843), Thomas Carlyle (1795–1881), Samuel Coleridge (1772–1834); Charles Dickens (1812–70), Charles Reade (1814–84), John Ruskin (1819–1900), Matthew Arnold (1822–88), William Morris (1834–96), Ralph Waldo Emerson (1803–82), George Sand (Madame Dudevant) (1804–76) and Leo Tolstoy (1828–1910). Of this group the most important were Carlyle, Ruskin, George Sand and Tolstoy. Carlyle is significant chiefly as a critic of materialism and the economic abstractions of the classical school. He had no constructive program of reform further than a willingness to wait for some unique genius to appear with a ready-made solution. Ruskin was as bitter as Carlyle in his criticism of the new industrial society and its ideals, but he offered some solution of the problems through his advocacy of a restoration of the dignity of labor, the institution of a régime of industrial co-operation, state-education, government workshops and state insurance for the working classes. A part of his program bordered on the gild-socialism of a slightly later period, but he set education above all other types of relief for the situation. George Sand, of a slightly earlier period, imbibed freely the utopian and revolutionary socialism of the «forties» in France, and by her writings did much to popularize these notions, in particular the doctrines of Pierre Leroux. Tolstoy's reform program was especially retrogressive and irrational. He advocated a complete abandonment of the new industrialism, a return to an agrarian age and the organization of the agrarian economy according to the principles of the Russian *Mir,* with its communistic practices considerably expanded. While one can appreciate the real and valid motives for this revolt of the æsthetic temperament against the repulsive features of modern industrial society, this group offered little in the way of workable constructive reforms. Few, except those who went over to socialism, had any real reform program. Only an insane person could accept the proposal of some of them that society should revert to a pre-Industrial Revolution economy where kings lived with less comforts than the average workingman of to-day. Further, even those who, like Ruskin, had some program to offer were scarcely in line with modern industrial democracy, but desired the establishment of some sort of authoritative and benevolent paternalism. In spite of all this, the æsthetic protest was a real contribution to the reform cause, for it effectively insisted that an increase in material gain was no complete justification of a new order of civilization and maintained that modern industrialism must make a place for the realm of the ideal and the æsthetic. The more recent circle of literary critics, of the social order, like Émile Zola, Anatole France, Bernard Shaw, H. G. Wells, John Galsworthy, Maeterlinck and Upton Sinclair differ from most of their predecessors in that, instead of favoring a return to a more primitive economy and social order, they are among the most ardent exponents of radical social reform. Only a few, enamored with the best of older civilizations and seeing only the darkest phases of the present order, have looked back with longing eyes to a by-gone age. In this class may be put Profs. J. P. Mahaffy and Warde Fowler, Ralph Adams Cram and J. A. Symonds.

E. *Utopian Socialism and the Reconstruction of the Social and Economic Environment.*— It has already been shown that those extremely radical schemes of social reform, which are conventionally known as «utopian,» appear in the greatest numbers after some great transition which brings with it an abnormal degree of misery. The Industrial Revolution, the greatest of all such transitions and probably the most productive of accompanying misery, naturally brought forth an unprecedented number of utopian plans for the solution of existing social problems, but all of these programs were more realistic and practical than the somewhat fanciful utopias of the 17th century. In the most fundamental sense utopian socialism of the first half of the 19th century was a revolt against the semi-fatalism of the premises of economic liberalism, which had represented society as the product of natural laws and forces, had accused the proletariat of being the authors of their own miseries and sorrows and had sharply denied the possibility of improving conditions artificially through constructive legislation. Utopian socialism denied this premise of Romanticism, individualism and economic liberalism and revived the notions of the French Revolution to the effect that human intelligence and ingenuity were fully equal to the task of forging a new social and economic order. They held that human nature is primarily the product of the social environment and that, accordingly, the solution of the contemporary evils was to be found in the creation of a better set of social institutions and practices. They maintained that man can by rational thought determine his own social system and social relations, and some, like Fourier, even claimed that man may by well-conceived legislation anticipate the normal course of social evolution.

The initiator of the utopian schemes of this period is conventionally assumed to be Count Henri de Saint-Simon (1760–1825), though he can be quite as much regarded as the formulator of the chief theses of Comtian sociology and a forerunner of Christian Socialism, and though there is no doubt that the other utopias would have appeared out of the surrounding conditions had Saint-Simon never written. Probably Saint-Simon's most important contribution to social science and ultimately to social reform was his contention that the social problems created by the Industrial Revolution were of so serious a sort that a distinct science of society, or of social reconstruction, must be evolved to deal with them. This goal was at last realized with the foundation of scientific sociology in the works of Auguste Comte, Herbert Spencer and the early Organicists. Saint-Simon's practical program of reform rested upon the reconstruction of society according to two somewhat divergent proposals, namely, the restoration of the practices and principles of primitive Christianity and the handing over of society to the control of a group of industrial experts who would reorganize things in a rational and humanitarian manner. His emphasis on the ability of a purified Christianity to solve current political questions constituted an impulse to the later development of Christian Socialism, while his proposal for a scientific direction of modern industrial society was elaborated by his disciple, Auguste Comte, in the latter's 'Principles of a Positive Policy.' The disciples of Saint-Simon developed his diverse notions. Enfantin and Bazard emphasized the communistic principles which were to be found in that primitive Christianity which Saint-Simon had so much admired. Leroux defended the notion of the social and moral equality of men and stressed the concept of the essential and desirable solidarity of society and of the interests of all social classes. Comte attempted to systematize the new social science of which Saint-Simon had seen the need. The greatest of the French utopians was François Marie Charles Fourier (1772–1835). He was one of the most thorough believers in the possibility of reforming mankind through the creation of an ideal social environment. This he believed would be found in an "apartment-house utopia" — a co-operative community or phalanstery of some 1,800 individuals. He hoped ultimately to see human society reconstituted as a world federation of phalansteries, the capital of which was, significantly, to be located at Constantinople. Fourier, wisely, did not plan a society which would wholly abolish all private property or attempt to equalize all classes and individuals, but worked out what he believed to be a proper fractional distribution of the social income between labor, capital and enterprise. While he did not profoundly affect France, no other member of the utopian group attracted so large and sympathetic a following in America and many phalansteries were established in the United States, the most famous of which was Brook Farm, founded and conducted by some of the most noted members of the "Brahman caste" of New England literary lights. The remaining French utopian reformer was Etienne Cabet (1788–1856), whose followers established an experimental community first in Texas and later in Nauvoo, Ill. The leading English utopian was Robert Owen (1771–1858), who came into the field of utopian theorizing fresh from a practical demonstration of the possibility of establishing an ideal industrial community. At the cotton mills in New Lanark he had organized an advanced industrial community, which, at the opening of the 19th century, possessed most of the features which characterize the more progressive industrial organizations of the present day and which was unique at that time. While Owen gave his support to almost every type of constructive philanthropy which was current in his day, he is known especially for his agitation in the cause of factory legislation and trade-unionism, his vigorous advocacy of industrial co-operation and his concrete plan for ideal industrial communities. The latter did not differ markedly from that of Fourier, though each group was to be slightly smaller. Though his plan was adopted in several places in the United States, most notably at New Harmony, Ind., it resulted in little practical success, and the enduring mark which Owen left on social reform consists chiefly in his support of every means of aiding the solution of existing evils and his emphasis upon the peculiar virtues in co-operation. But significant as were the premises and the achievements of utopian socialism in emphasizing the ability of society consciously and artificially to solve its own problems, this type of socialism could scarcely lead directly into Marxian socialism. It was too impractical and, from the standpoint of the Marxian, it was not sufficiently democratic. The Utopians did not set forth plans designed to aid the proletariat alone, but aimed at a reconstruction of all of society. In a very real sense they were as much the forerunners of modern French "solidarism" as of Marxian socialism. Between utopian and Marxian socialism there intervened the stage of "transitional socialism" by which socialism was made a revolutionary and a proletarian movement. More recent echoes of the utopian movement have been William Morris' 'News from Nowhere' and Edward Bellamy's 'Looking Backward.'

F. *Transitional or Revolutionary Socialism.* — The most important figures in the so-called transitional socialism were the Irishman, William Thompson (1785–1833); the Frenchmen, Louis Blanc (1813–82) and Pierre Joseph Proudhon (1809–65), and the Germans, Wilhelm Weitling (1808–70), and Ferdinand Lasalle (1825–64), though Proudhon played a more prominent part in founding modern anarchy and Lasalle is equally distinguished as an advocate of state socialism. As far as his practical reform program is concerned, Thompson was a disciple of Robert Owen, but his 'Inquiry into the Principles of the Distribution of Wealth most Conducive to Human Happiness' (1824) contained a very clear statement of the famous Marxian postulate of the doctrine of «surplus value.» He maintained that labor produces all value and should get the whole product, but under capitalistic society it is exploited out of a great part of its just income. Louis Blanc was one of the first to insist that the only effective help which the proletariat could expect must come from their own efforts. He believed that the laboring classes would have to triumph through revolution, and his post-revolutionary program consisted in «social workshops,» which practically meant state support and control of industry according to a democratic plan of organization. In the French Revolution of 1848 his plan was tried, but, as it was operated by his enemies who solely desired to discredit it, the scheme proved a hopeless failure. Proudhon made an especially bitter attack upon the institution of private property, or rather upon the abuses of private property which then existed. But he was equally critical of the doctrine of communism. He proposed to base the income of everyone solely upon the amount of labor performed, the unit value of which was to be equal and uniform among all members of society. He attempted to secure the establishment of a national banking system founded upon this labor script following the Revolution of 1848, but he failed utterly in this. Standing at the opposite pole from Say and Bastiat he is chiefly significant for his effective onslaught upon the abuses of the bourgeois régime. Weitling, a Magdeburg tailor who later came to the United States, anticipated Marx by a comprehensive and trenchant review of the evils which modern industrialism had brought to the workingmen and by an eloquent appeal to the proletariat, urging them to rise in their own behalf and overthrow their capitalistic oppressors. Lasalle stressed the fact that the laborers could only escape from bondage through political activity and assumed a leading part in urging and guiding the formation of a labor party in Germany. His concrete plan for reform was state workshops much like those proposed by Louis Blanc, but this phase of his doctrines and activity had little subsequent influence. Transitional socialism, thus, in many obvious ways prepared Europe for Marxian socialism.

4. Early Philosophical Anarchism.— It might be thought that the economic liberals had attained unto the most perfect apotheosis of the individual, but another contemporary school exceeded them in this respect, namely, the earliest philosophical anarchists. The economic liberals proposed to retain the state for at least the function or preserving life and protecting property, but the anarchists declared for the total abolition of the state and all coercive juristic institutions. The first of this group was William Godwin (1756–1836), whose 'Inquiry Concerning Political Justice' (1793) was probably the best example of the adoption of the extreme notions of the French Revolution by an English social philosopher. He held that all evils in society result from the detrimental effect of coercive human institutions. He proposed that all collective organizations larger than the parish should be abolished; that the unequal distribution of wealth should be done away with; that the institution of marriage should be wiped out; that mankind should be free from everything save the moral censure of their associates and thereby made ready for their ultimate perfection through the influence of reason. Proudhon inveighed mightily against the state which he regarded as wholly an institution for exploitation and oppression. His ideal society was to be founded upon that combination which may be created in metaphysics, but which has never yet been realized as a practical condition, namely, «the union of order and anarchy.» He believed that if the obligations of contract could be enforced society would function perfectly, but he scarcely comprehended that until human nature has reached a higher state of perfection there can be no certain enforcement of contractual obligations without the force of the law behind them. While both Godwin and Proudhon had rejected the utility of the state they had stressed the importance of society— of the concept of humanity. It was left for Max Stirner (1805–56) in his 'The Ego and His Own' (1844) to exalt the individual above even humanity and society, to assert that the individual constitutes the only extant reality, to maintain that the only limitation upon the rights of the individual is his power to obtain what he desires, and to contend that «the only right is might.» While these early anarchists were guilty of many excesses of statement and offered no well-reasoned substitute for the state which they proposed to destroy, they did perform a real service in insisting that the state, as long as it was undemocratized, was unjustly oppressive and a legitimate object for the suspicion of those who were excluded from participation in it.

5. The Political Revolutions of 1848.— In the winter and spring of 1848 the masses throughout central, southern and western Europe rose in the attempt to secure for themselves freedom from oppression through participation in political activity. In the German states freedom from political autocracy was desired; in the Hapsburg realms and in Italy not only political liberty, but also freedom from the social and economic burdens of feudalism were aimed at; in France political participation and the overthow of the oppression of the bourgeoisie were the goal; and in England the «Chartists» hoped to achieve economic betterment and that part in the world of politics which had been denied to them in the Reform Bill of 1832. For various reasons, primarily from a division of the Revolutionists through national, party or economic rivalry, the movements failed in every country, though the abolition of serfdom in the Hapsburg possessions was made a permanent achievement. The failure of these political revolts of the masses turned many into a following of economic channels of attack upon the forces of privilege.

The programs of social reform in the first half of the 19th century had cleared away the archaic obstructions inherent in Mercantilism and had made vigorous assaults upon the succeeding régime of industrialism and economic liberalism from almost every angle, ranging from an æsthetic protest to political and economic rivalry. In England some progress had been made toward the beginnings of constructive factory legislation, but elsewhere little had been achieved along this line. Nowhere were workingmen freely allowed the right of self-protection through organization. In no major European country did political democracy exist in 1850. There were few constructive programs of social reform of a concrete or practical nature. Only in Prussia was there any free public education. But, in spite of these early failures to achieve permanent results, the ground was being prepared for the rise of those reform movements which have brought the beginnings of economic as well as political democracy into the modern world.

VI. THE RISE OF PRESENT-DAY SOCIAL THEORIES AND SOCIAL REFORM PROGRAMS.

1. The Historical Background.— Before 1850 the new industrial order had thoroughly taken hold only of England but had affected France to a considerable degree. The other European countries were little affected by the Industrial Revolution until the last third of the century. When the new industrialism came to these states it produced a wider following for the programs of reform. Again, the first half of the century was spent by the proletariat and their champions in groping about feeling their way, in formulating impracticable programs and in discovering successful methods of organization and achievement. After 1850 this preliminary training began to bear fruit in successful proletarian movements in both the political and the economic fields. Further, the mad rush for wealth tended to slow down to some degree and even the capitalistic classes became more resigned to the coming of a moderate restriction of their absolute industrial freedom. Finally, the Darwinian biology made any static outlook upon social and economic problems absurd and preposterous.

2. The Effect of the German Philosophy of the State.— The political philosophy of both economic liberalism and utilitarianism had been built up about the thesis of the pre-eminence of the individual, and the state was looked upon as merely the «communal policeman.» Aside from the protection of life and property and the erection of public works the chief function of the state was represented as being the abolition of restrictive legislation previously enacted. The notion of the state as the chief instrument of social reform was wholly repulsive to this school and a new doctrine of the state was essential before extensive reform legislation could be given a respectable theoretical foundation. This new theory of the state was found in the doctrines of the German Idealist political philosophers, particularly Hegel. Here was discovered a notion of the state which was wholly reverent, took the community as the starting point of political reasoning and believed the individual capable of finding perfection only as a member of the state. This view was brought over into England by T. H. Green, F. H. Bradley and Bernard Bosanquet. Prof. Ernest Baker thus summarizes the nature and significance of this transformation in political philosophy: «Not a modification of the old Benthamite premises, but a new philosophy was needed; and that philosophy was provided by the idealist school, of which Green is the greatest representative. That school drew its inspiration immediately from Kant and Hegel, and ultimately from the old Greek philosophy of the city-state. The vital relation between the life of the individual and the life of the community, which alone gives the individual worth and significance, because it alone gives him the power of full moral development; the dependence of the individual, for all his rights and for all his liberty, on his membership of the community; the correlative duty of the community to guarantee to the individual all his rights (in other words all the conditions necessary for his and, therefore, for its own, full moral development)— these were the premises of the new philosophy. That philosophy could satisfy the new needs of social progress, because it refused to worship a supposed individual liberty which was proving destructive to the real liberty of the vast majority, and preferred to emphasize the moral well-being and betterment in and through the community. Herein lay, or seemed to lie, a revolution of ideas. Instead of starting from a central individual, to whom the social system is supposed to be adjusted, the idealist starts from a central social system, in which the individual must find his appointed orbit of duty.» This philosophy laid the foundation for state-activity, but it carried with it certain exaggerations and dangers which Professors Dewey and Hobhouse have recently revealed.

3. The Rise of Scientific Sociology.— The general science of society, or sociology, took its origin, as Professor Small has made clear, from the social conditions and reform programs of the first half of the 19th century, which called for some objective science capable of weighing the merits and detecting the defects in the many plans for social reform. Saint-Simon had recognized the need for such a science and it was founded by his disciple, Auguste Comte, and by Herbert Spencer, though there can be no doubt that the science would sooner or later have come into existence had these men never written. Since their day sociology has attracted many students and many schools of sociologists have developed, each embodying some fertile method of approach to the diverse problems with which sociology must concern itself. Comte, Spencer, Giddings, Ward and Hobhouse have developed comprehensive systems of social philosophy; the methodology of the science has been perfected by such men as Le Play, Durkheim, Small, Simmel and the statisticians, such as Quetelet, Jevons, Galton, Pearson, Bowley, Mayo-Smith, Willcox, Chaddock, Hankins, Durand and others; the biological point of approach has been cultivated by the Organicists like Lilienfeld, Schaeffle, Worms and Roberty and by their more critical successors; psychological sociology has been advanced by Bagehot, Wallas, Trotter, Tõnnies, Tarde, Durkheim, Le Bon, Sighele, Ross, Ellwood, Cooley and Sumner; the conflict between social groups and interests has been dealt with by Gumplowicz, Ratzenhofer, Oppenheimer, Small and Bentley; the historical mode of approach has attracted Thomas, Hobhouse, Giddings, Westermarck and Durkheim; the significance of geographical factors has been shown by Ratzel, Reclus, Brunhes and Semple;

while close contact with social reform has been made by the scientific students of philanthropy like Webb, Devine and Taylor and a sound basis for social legislation has been formulated by Jethro Brown, Pound, Freund and Lindsay. The attitude of sociologists toward state activity has varied greatly. Comte believed in a thorough program of social reform, but Darwinian biology affected sociology much as Newtonian mechanics had affected political and economic thought for two centuries before. Sociologists of individualistic leanings, like Herbert Spencer and William Graham Sumner, interpreted the Darwinian doctrine to mean that social institutions, like the animal organism, evolved in a spontaneous and automatic manner and that human efforts could only be harmful — a view similar to that entertained by the Physiocrats toward interference with the «natural order» of physical and social phenomena. Others, particularly Profs. Lester F. Ward and Leonard T. Hobhouse, have contended that, while the earliest stages of social evolution are spontaneous, there comes a time when social progress may be artificially controlled and accelerated by the conscious direction of mankind. This dividing line will apparently be reached when statesmen shall have evolved into sociologists. Most sociologists, following Jevons, have avoided dogmatism on this point and have shown that *laissez-faire* and state socialism are policies which may each have their virtues in proportion as they are adapted to a given society, but sociologists are more and more coming to leave the individualist point of view and to stand with Ward and Hobhouse in favoring extensive state activity. While it can scarcely be said that every sociologist is on that account a talented statesman, it is certain that no scientific program of social reform can be formulated independent of sociological investigations or divorced from sociological principles.

4. The Development of Marxian or «Scientific» Socialism.— The origins of the so-called «scientific» socialism are generally and correctly associated with the work of Karl Marx (1818–83) and Friedrich Engels (1820–95). As Prof. Bertrand Russell has well said, «Socialism as a power in Europe may be said to begin with Marx. It is true that before his time there were Socialist theories, both in England and in France. It is also true that in France, during the Revolution of 1848, Socialism for a brief period acquired considerable influence in the State. But the Socialists who preceded Marx tended to indulge in Utopian dreams and failed to found any strong or stable political party. To Marx, in collaboration with Engels, are due both the formulation of a coherent body of Socialist doctrine, sufficiently true or plausible to dominate the minds of vast numbers of men and the formation of the International Socialist movement, which has continued to grow in all European countries throughout the last 50 years.» It would probably be futile to attempt to indicate all the sources of Marx's views, for he read deeply in all the literature of his age and was in contact with most of the tendencies of his period, but a few of his more conspicuous obligations may be set down. To Hegel he was indebted for his dialectical system and his faith in state activity; his materialistic philosophy of history he took from Feuerbach; the labor theory of value was derived from Ricardo and Rodbertus; the doctrine of surplus value was found by Marx in the writings of Thompson; the notion of a class conflict and of the necessity of a proletarian upheaval was found in the works of Louis Blanc, Proudhon and Weitling; while from Sismondi he received his conviction that the capitalists would be weakened by the progressive concentration of wealth in the hands of a few men of great possessions. The 'Communist Manifesto,' a document drawn up by Marx and Engels for the German Communist League in Paris in January 1848, contained the essence of Marxian socialism. This begins with the economic interpretation of history, the contention that the prevailing systems of the production and distribution of wealth determine the accompanying social and political institutions. Then comes the labor theory of value, the belief that labor produces all value. From this is derived the doctrine of surplus value by pointing to the difference between the total social income and that received by labor. This difference is the surplus value created by labor and out of which it is exploited by the capitalist. Hence there arises the notion of an inevitable and irreconcilable struggle between the proletariat and the capitalists. This cannot but terminate in the overthrow of the latter, for they are being continually weakened by the steady concentration of wealth in the hands of their more powerful representatives, while the proletariat will become progressively stronger through party organization and the obtaining of the suffrage. When they shall have secured a majority in the law-making bodies of the several states the proletariat will rise up and expropriate their oppressors and institute the régime of social and economic democracy which Marx predicted but wisely refrained from describing in detail. These doctrines were elaborated with greater thoroughness and in more ponderous and obscure language in the work on 'Capital' begun by Marx and completed by Engels. The enduring theoretical contributions of Marx are his economic interpretation of history and his extremely effective criticism of the individualistic industrialism of the first half of the 19th century, the latter of which «cannot but stir into fury any passionate working-class reader, and into unbearable shame any possessor of capital in whom generosity and justice are not wholly extinct.» Few if any of Marx's other major doctrines are now regarded as possessing substantial validity.

Marx was also instrumental in establishing socialism as a political force in Europe. The International Workingmen's Association took its origins for a conference of laborers at the London International Exhibition of 1862. It was organized at London two years later and its principles were drawn up by Marx and adopted at the Geneva conference two years afterward. A German wing started by William Liebknecht in 1864 and, under his leadership and that of August Bebel, it was developed into the Democratic Workingmen's Association at Eisenach in 1869. In the meantime a German General Workingmen's Association had been organized and its program enunciated by Lasalle in 1863. These two groups coalesced at

Gotha in 1875 and created the German Social Democratic party. Persecuted by Bismarck from 1878 to 1890 they grew in power until they commanded 110 out of 397 votes in the Reichstag of the old empire and have now captured in a seemingly permanent manner the German government.

The beginnings of the modern French political organization of labor dates back to 1878. Two years later French Marxianism was originated under the leadership of Jules Guesde. But the French socialists for a long time were unable to arrive at the same unity that characterized the party in Germany. Numerous sects developed and there grew up much bitter feeling, particularly between the Marxians, led by Guesde, and the Revisionists or Opportunists led by Jean Jaurès, the ablest figure in the history of modern socialism. An effort to unite these factions failed in 1899, but met with more success in 1905, and the United Socialist party was able to elect 102 out of 602 members of the Chamber of Deputies in 1914, besides 18 members of the allied Independent Socialist party.

The Socialist party organization has made rapid progress in a number of the other chief European countries, notably Austria, Italy and Russia and has reached remarkable strength in some of the lesser states, particularly Finland, Sweden, Denmark and Belgium. In part, this has been the result of the increased strength of the proletariat and, in part, the effect of a moderation of socialistic proposals which has attracted many liberals who refuse to accept Marxian postulates.

5. The English Fabians and the Growth of "Revisionist" Socialism.— In spite of the significance of Marxian socialism in attracting a sufficient following to make it a political and economic movement of the greatest importance, it possessed certain obvious theoretical difficulties which embarrassed its more thoughtful supporters and gave its enemies a vulnerable point of attack. These weaknesses were chiefly the untenable labor theory of value and the deductions from it, and the refusal of the Marxians to co-operate with existing capitalistic governments in securing remedial legislation for the proletariat. A program of reform which was not to begin until after a remote and complete social revolution had been achieved was much less attractive than one which would accept partial amelioration on the road to complete triumph.

This situation was first adequately comprehended by a group of English radicals known as the Fabian Society. They organized out of a general sympathy with socialistic propositions which had been brought before them, in part, by English followers of Marx, like William Morris and H. M. Hyndman, and, in part, by two American radicals, Henry George and Thomas Davidson. The most important members of this group were Sidney Webb, Graham Wallas, Bernard Shaw, Chiozza Money, Edward Pease, H. G. Wells and Stewart Headlam. They derived their name from the Roman leader, Fabius, and their resolution to delay their final convictions until the socialistic movement had developed further. They relied chiefly upon the hope of arousing an intellectual movement in favor of radical social reform and their great significance lies in the fact that they repudiated the fatalism of Marx and came out for "opportunism," or remedial social legislation through the agency of the existing political organization. They made socialism an evolutionary rather than a revolutionary movement. They were also less enamored with the internationalism of Marx and laid greater stress upon national progress in social reform.

While the Fabians originated the tenets of "Revisionism" the spread of this movement was due more to the agitation of a German socialist savant, Edouard Bernstein (1850–). Bernstein lived in England during the period of the socialist persecution in Germany and was converted to the ideas of the Fabians. Returning to Germany in the early "nineties" he began the dissemination of his new convictions and in his work on 'Evolutionary Socialism' he systematized his principles, which were chiefly a denial of the Marxian economics, especially the labor theory of value, a declaration for "opportunism" or piece-meal remedial social legislation, a willingness to co-operate with existing governments and more concessions to the principles of nationalism and patriotism than the Marxians would allow. In other words, he aimed at the practical transformation of socialism from a proletarian party of revolution into a party of radical social reform which could attract the support of non-Marxian liberals. While he was not able to capture the German Socialist party until after the death of Bebel and the elder Liebknecht, the Marxians now constitute a hopeless minority among German socialists and many of the Revisionists have even passed Bernstein in the degree to which they have modified the Marxian doctrine and program. The general history of socialism in every important modern state has been much like that of German socialism; Marxianism has served as the entering propaganda and the growth of the movement has led to the domination of Revisionism. Only in Russia, where socialism did not have long enough a period of development to allow the triumph of "opportunism," have the Marxians remained in the majority. The leading Revisionist Socialists have been Jaurès in France, Emile Vandervelde in Belgium, Filippo Turati in Italy and Peter Struve and M. Tugan-Baranovsky in Russia. The intellectual leaders of socialism in the United States have also generally capitulated to Revisionism, though the majority of the party clings to Marxian principles. Thus, as socialism has increased in strength it has developed moderation. This has been due, in part, to the greater validity and practicality of Revisionism and, in part, to the very growth of socialist power for, as Professor Orth has well put it, "ambition brings power, power brings responsibility, responsibility sobers the senses." Socialism has in this manner been purged of the nightmare of revolution, except in Russia, and while it is undoubtedly increasing in strength almost everywhere it can no longer frighten any person except the one who opposes the very principle of progress.

6. The Rise and Expansion of State Socialism.— Closely related to the principles and program of Revisionist Socialism and in part contributing to the growth and vitality of the former is the so-called "State Socialism." The chief difference between them is that state socialism has primarily come from radical bourgeoisie instead of moderate socialists, though it must be remembered that in some cases, most notably in that of Bismarckian social legislation, state socialism has been used to aid autocracy and check radicalism. The same general program of remedial legislation is proposed by both, though their ultimate goal is slightly different. The Revisionist hopes for an ultimate proletarian state but plans to ease as much as possible the passage of the capitalist over the Jordan of social democracy, while the State Socialist hopes to retain the capitalistic system with great concessions to the laboring classes. State socialism received some considerable impulse from Lasalle, but its chief early leaders were the German, Karl Johann Rodbertus (1805–75), and the Frenchman, Charles Brook Dupont-White (1807–78). More recently the program of state socialism has received not only the support of statesmen in the German Progressive party, the French Socialist Radical party and the English Liberal party, but also in different degrees from the professorial champions of social reform within the capitalistic state, the so-called «Socialists of the Chair,» such as Schaeffle, Wagner and Schmoller in Germany; Bouglé and Gide in France; Webb, Hobson and Hobhouse in England, and Fetter, Fisher, Patten, Seligman and Seager in the United States.

State socialism in actual legislative achievement has made the greatest progress in Germany where there has been enacted an elaborate program of social legislation covering almost every phase of protection to the laboring classes. It has also included the adoption of the state ownership of railroads and other public utilities and a vast amount of municipal socialism. France has made extensive progress in this direction in the latter half of the period of the Third Republic, and Italy, as well, especially in the liberal régime since 1900. Austria has followed much of the example of Germany in this movement, while in England, the home of economic liberalism, even the party of Cobden has been converted to state socialism through a process of change which Professor Hobhouse has clearly explained. Its vigorous leader, David Lloyd George, has secured, in the period since 1905, the adoption of a legislative reform program designed to make Cobden turn in his grave and rivaled in content only by German achievements. In the United States state socialism made scant progress until the «accident at Buffalo» put Mr. Roosevelt in the Presidential chair. Down to that time the plutocratic admirers of the philosophy of Cobden and Bright, such as Roscoe Conkling and Mark Hanna, had maintained individualism in a position of dominance. While Mr. Roosevelt achieved relatively little in the way of positive remedial legislation, he aroused the spirit of the people in this direction and made possible the very considerable progress in advanced social legislation which has taken place in Mr. Wilson's administration. Of all the enemies of the political postulates of economic liberalism state socialism has to date been the most deadly in practical results.

7. Recent Developments of Christian Socialism.— The growth of social problems and the development of programs of relief have not been without their reaction upon ecclesiastical organizations and policies since 1850. The Catholic party has been especially active in this matter. In Germany, Adolph Kolping (1813–65) proposed associations of young workingmen for religious as well as economic betterment; Bishop von Ketteler (1811–77), F. C. J. Moufang (1817–90) and Franz Hitze (1851–) advocated not only social legislation, but also the organization of gild-socialism under Catholic auspices, but with state financial support, as the best agency for solving modern industrial evils. The program was designed, in part, to weaken the state, the secular rival of the Church, and, in part, to attract the proletariat to the ecclesiastical authorities. The Catholic party in Germany has been strongest in Bavaria, from which the Center party, always an exponent of social reform, has been chiefly recruited. In Austria, Karl Lueger (1844–1910) adopted the program of the German Catholic gild-socialists and organized the powerful Austrian Christian Socialist party. In France, Frédéric LePlay (1806–82) proposed to solve modern social and economic problems by developing the «family group»— an organization midway between the old patriarchal family and the modern family organization. But much more important than this for social reform was his method of studying social problems, for he is rightly regarded as the real originator of the social survey method of social investigation. Much more influential has been the work of Albert de Mun (1841–1914), who accepted the gild-socialist program and organized the Action Libérale Française, virtually the Catholic socialist party of France. Hilaire Belloc and Gilbert Chesterton have tried without success to organize a similar movement in England. Even the liberal Pope, Leo XIII, in his encyclical, *Rerum novarum*, sent out in 1891, advocated remedial social legislation for the laboring classes, espoused the program of gild-socialism and maintained the special solicitude of the Catholic Church for the lowly laborer, whether urban or agrarian.

The social impulse has also affected Protestanism in recent times. In Germany, the fanatical Hohenzollern court preacher, Stöcker, organized what was called a Christian Social Workingmen's party, but which was in reality more Anti-Semitic than either Christian or socialist. Friederich Naumann in the «nineties» also made an unsuccessful attempt to capture German Protestantism for a radical social reform policy. In France, the Protestants have been noted for their philanthropic organizations, but they have never been strong enough to create a powerful party of social reform. In England, the work of Maurice and Kingsley has been carried on by aggressive Anglicans, like Bishops Westcott and Gore, who founded the Christian Socialist Union in 1889, and like John Neville Figgis, who formulated an elaborate theoretical justification of what might be called ecclesiastical syndicalism. In America Christian Socialism was founded in the late «eighties» by Josiah Strong, and Profs. Richard T. Ely and George D. Herron and received its most effective support from Prof. Walter Rauchenbusch in his famous works, 'Christianity and the Social Crisis,' and 'Christianizing the Social Order.' Other adherents to this point of view have been Professors Francis Peabody of Harvard, C. R. Henderson and Shailer Matthews of Chicago, Harry Ward of Boston, E. L. Earp of Drew and P. A. Parsons of Syracuse. The social point of view has attracted religious radicals as well as conservatives. Indeed, it is probable that the critical adherents to Christian doctrines are the most inclined to stress the social phases in Christianity, for with them the social and ethical elements are about all that remains to be saved and expanded.

8. The Newer Anarchism and the Attacks upon the Bourgeois National State.— Modern anarchism is a revolt against the oppressiveness of the agrarian or the capitalistic state. It is most significant that the two leading figures in the development of the modern anarchist movement have been Russians. At a time when modern industrialism was creating new problems and bringing the necessity of modern democracy nearer to hand, the Russian autocracy tried to maintain a system of government as mediæval and intolerant as at the time of Peter the Great. Michael Bakunin (1814–76) was the revolutionary propagandist of the two great leaders of modern anarchism. He paid little attention to the problem of the details of the future anarchist state, but regarded his chief task to be the spreading of the propaganda of hatred for the state and the organization of a movement committed to its destruction. To him the state appeared as the great and central engine of human oppression and its elimination seemed the one chief need of the time. Once the state was removed the task of the reconstruction of society on anarchistic principles could safely be left to the future generations. Hence, the work of Bakunin was chiefly the dissemination of the gospel of destruction, his views being most systematically expressed in his 'God and the State,' where he maintained loyalty to state and religion to be the chief obstacles to social progress and human liberty. Prince Peter Kropotkin (1842–) is the chief systematic and constructive writer on modern anarchism. According to him the ideal organization of society is the non-coercive community without private property and functioning perfectly through the operation of the principle of mutual aid or co-operation. To support his position he has not only made a theoretical defense of his system, but has also executed a thorough historical study of the importance of the principle of mutual aid from the first animal societies to the present day and has brought forward a wealth of evidence to prove this the chief factor in social evolution, the happy operation of which was terminated by the rise of the modern dynastic and capitalistic state, which has created most subsequent evils without in any way contributing to their effective removal. The communistic, co-operative and non-political group, then, is the goal of the philosophical anarchist. Human nature having been perverted by political institutions, the removal of the latter will restore the pristine virtues of the race — a notion not far removed from the burden of Rousseau's famous second 'Discourse.' The anarchistic views have also received the support of such writers as the Russian, Léon Metchnikoff, and the Frenchmen, Elisée Reclus and Jean Grave. The economic program of the anarchists is not greatly different from that of the socialists, as far as the institution of private property is concerned, but their political ideals are diametrically opposed. The socialist proposes a vast increase in state activity, while the anarchist desires the complete extinction of political authority and the substitution of voluntary co-operation. The anarchists have erred in generalizing too much from Russian conditions, which have been incomparably worse than in the more democratic states of western Europe. Further, their movement is entirely unadapted to modern conditions. They are either antiquated or greatly ahead of their time. Voluntarily co-operation may have been possible in a small primitive group or it may be practicable in the far distant future when human nature shall have been perfected, but scarcely at the present time when imperfect humanity faces a complexity of problems of unprecedented volume and when the state is more than ever necessary. The anarchists have done good in showing how much oppression has resulted from autocratic states and in stressing the unexploited potentialities of co-operation, but the remedy would seem to lie in the improvement of the state through democracy and decentralization rather than in the extinction of political authority.

9. The Development of Trade-Unionism and Its Relation to Social Reform.— It was one of the cardinal points of economic liberalism that perfect freedom of contract should prevail in the economic relations of employer and employee, but in actual practice the freedom was chiefly that of the employer to reject the services of the employee. Where one party to the contract could refrain from participation with equanimity while the other party would be threatened with starvation, there could be neither freedom nor equality of contract; unorganized labor was thus wholly at the mercy of the capitalistic employer. On the other hand, if the laborers could combine and withhold the services not merely of one man, but of a large number, the concern of the employer over the failure to make the labor contract could be greatly increased, while the suffering of the employees could be lessened through co-operation in bearing the mutual loss. The desire to meet the employer on relatively equal terms has been the central impulse in the development of modern trade-unionism. The question has often been raised as to the relation between the modern trade-unions and the older gild organizations. It has been shown pretty conclusively that there was no genetic connection between them; in England there was a long hiatus between the end of the gilds and the origin of unions, and even on the Continent there is little evidence that trade-unions grew up out of previous gild organizations.

In England, trade-unionism was early prohibited by the Combination Laws of 1799 and 1800. In 1824 Francis Place and Joseph Hume smuggled an act through Parliament legalizing organization, but this was repealed in the following year. Owen's attempt to stimulate unionism in the "thirties" failed. In the "sixties" the cause of unionism was taken up by the so-called "Junta," made up of Allen, Applegarth, Coulson, Guile and Odger. By acts of 1871 and 1875 organization and strikes were legalized. Though the reactionaries in the

Taff Vale and the Osborne cases (1901 and 1909) tried to weaken the unions, the Liberal party in legislation following 1905 has practically abrogated the effects of these decisions. To-day labor organization is probably the most effective aid to the English urban proletariat. At the outbreak of the World War these unions had about 3,000,000 members. In France, an act of 1864 gave the laborers the right to organize and a later law of 1884 authorized them to strike. Since that time there has been a great increase in the number of unionists, accompanied by a bitter struggle between those who cling to orthodox methods and those who incline toward the greater radicalism of the Syndicalist movement. The French labor unions now boast of over 1,000,000 members. In Germany trade-unionism was originally little impeded by opposing legislation, but it came under the ban during the anti-socialist campaign from 1878 to 1890. Since then it has been little restricted. Most of the German unionists are organized in Social Democratic or «Free» unions, embracing about 2,000,000 members. In no other important country have the unionists so faithfully maintained the ideals of excellent craftsmanship which were so characteristic of the mediæval gilds. Trade-unionism has spread to most other European countries, though in many, especially in the Romance nations, it has tended toward «Syndicalism.» In the United States extensive labor organization began following the Civil War with the Knights of Labor, an organization which declined after the violent strikes of 1886. Their place was taken by the American Federation of Labor, an organization which now numbers about 2,500,000.

The policies of labor unions have centred about two main avenues of attack upon the capitalists. Matters of immediate interest, such as wage agreements with employers, are arranged either by peaceful collective bargaining or by more violent action, such as strikes and boycotts. For the more general advancement of the status of the proletariat they rely upon the possibility of obtaining legislation favorable to the interests of the laboring classes. Which of these two policies is most stressed varies with different unions and in different countries, but, on the whole, it is probable that the strike policy has predominated. The degree to which the trade-unions have attempted to gain political power has differed widely with time and nation. In Germany, most unionists are members of the Social Democratic party; in France, orthodox unionists tend to affiliate with the socialists, while the radicals who incline toward «Syndicalism» eschew all political activity; in England, the unionists have a more or less distinct labor party of considerable proportions; in the United States, Samuel Gompers has attempted to keep the American Federation of Labor out of distinct political activity, though he has several times declared his own preference for candidates at Presidential elections. An accessory but very important feature of trade-unionism has been the development of fraternal and co-operative activities among members.

While the growth of organized labor has been one of the outstanding features of the social and economic history of the 19th century it is handicapped by many imperfections. The attempt to prevent violence through making arbitration of labor disputes compulsory has met with only temporary and local success, most notably in Australasia, though the tendencies seem to be moving in this general direction. Again, many powerful employers and associations of employers have even yet so little adjusted their economic orientation to the modern industrial world that they refuse to recognize the validity of the principles or the practices of labor organizations. As a result, the relations between capital and labor are too frequently of the nature of slightly mitigated industrial warfare. Finally, while there can be little doubt that labor organizations have done more than anything else to advance the material interests of the laboring classes in the last half century and have been the most potent factor in promoting industrial democracy, yet trade-unionism is bound to be unsatisfactory to those who do not believe in merely alleviating the misery of the proletariat, but hope to overthrow the whole modern capitalistic order. Orthodox trade-unionism aims chiefly to improve the lot of the laborer within a capitalistic industrial society, but accepts the implied persistence of this order. Therefore, those who wish the institution of a society controlled by the proletariat and desire to achieve this revolution by economic means rather than by the political methods of socialism have tended to leave trade-unionism and go over to the more radical labor movement which has found its greatest strength in «Syndicalism.»

10. The Development of Syndicalism and the Radical Labor Movement.— Syndicalism, which originated as a French labor movement and has since spread to other countries, particularly Italy and America, is the most recent radical proletarian movement of any significant proportions to develop. Syndicalism resembles socialism in desiring to end the present capitalistic economic order; it bears some similarity to trade-unionism in believing that the economic point of attack is most likely to be most effective and in using labor organization as the chief instrument for gathering the forces of the proletariat; it is like anarchism in desiring the abolition of political forms of control over mankind. It differs from socialism in rejecting the efficacy of political activity and in refusing to accept state socialism, even in a proletarian state; it diverges from trade-unionism in favoring, as the unit of organization, the industrial rather than the craft union and in aiming to get rid of the capitalistic employer altogether; and, while bearing a closer relation to anarchism than to socialism, it does not propose so thorough an abolition of all existing institutions as the anarchist desires, and it seems likely to retain a far greater amount of authorative control over the members of the syndicalist society, even though it may try to evade this in theory by refusing to designate such control as governmental or political.

The historical origins of French syndicalism are not difficult to understand. A vigorous theory of the necessity of a class war had come down from Proudhon. The many factions into which French socialists had split and the bitter animosity which developed between them weakened the cause of the proletariat, and the socialist cause was further discredited with the radical laboring element because former socialists like Millerand and Briand had been willing, when they entered the French government, to use the forces of the capitalistic state against radical labor revolts. Therefore, there arose a determination among a large number of French labor leaders to turn their back upon all political activity, and to distrust political methods of relief whether from state socialism or Marxian revolutionary hopes. At the close of the "eighties" labor exchanges were organized, first in Paris, and later throughout the leading French cities, to act as a general clearing-house for local labor problems and policies. In 1892 they established a national organization — the Federation of Labor Exchanges (*Fédération des Bourses du Travail*). This movement was guided by Ferdinand Pelloutier (1867–1901), a French disciple of communist anarchism. At about the same time another radical labor organization was developing in France. This was the General Confederation of Labor (*Confédération Générale du Travail*), founded in 1895 by a union of some 700 French local industrial unions or *Syndicats,* from which the syndicalist movement gets its name. In 1902 the Federation of Labor Exchanges and the General Confederation of Labor united and became the basis of the organized syndicalist movement. The systematic theorist of French syndicalism is Georges Sorel (1847–).

The syndicalists eschew any attempt to come to favorable terms with their capitalistic employers in any settlement which may be regarded as permanent. They aim frankly and openly at conducting a class war by industrial methods which will sooner or later drive the capitalist from industry and overthrow his political bulwark — the modern national state. The unit of organization at which the syndicalists aim is the industrial union, the general organization of all laborers in a given industry, which, it is hoped, will give greater strength and less division of interests than craft unionism. Their method of carrying on the class war is the so-called "direct action," the two chief types of which are "sabotage" and the "general strike." The former is more of a temporary instrument designed to serve until the general strike finally drives the capitalist from the field. It consists in every type of harassing the employer, from serious injury to machinery, to slow and inferior workmanship in production. While some employers might be discouraged and abandon the fight merely as the result of sabotage, a more vigorous method will be needed to deal with the more obdurate capitalists and with the state, and for this purpose the syndicalists propose to resort to the general strike, which is not merely a suspension of labor to improve local conditions, but a general "cessation of work, which would place the country in the rigor of death, whose terrible and incalculable consequences would force the government to capitulate at once." Were the syndicalists successful in destroying the capitalistic order they would institute a communistic economic society and a governmental organization based upon the industrial system. As Professor Orth has well expressed it, "syndicalists believe in a local or communal government. Their state is a glorified trade union whose activities are confined to economic functions, their nation is a collection of federated communal trade societies." They would, then, take government out of the front-door of the state to bring it in by the back-door of industrial regimentation. Of all the radical modern reform movements syndicalism has come the nearest to translating the class war into practical concrete action and it is that form of organization and procedure into which the capitalists should most hesitate to drive the laboring classes. Aside from its own specific program, syndicalism has attracted a sympathetic study from many who are not willing to accept its whole economic program, but feel that something must be done to decentralize the overgrown and unwieldy modern national state and to give representative government a more rational basis, through allowing the representation of economic interests and classes. Further, many exponents of the more orthodox trade-unionism feel that they would gain greatly by giving up the craft union organization and accepting the principles of the industrial union organization. While syndicalism began as distinctly a French movement it has spread into other European countries, notably Italy. In the United States it has been adopted by a considerable group — the Industrial Workers of the World. From the combined influence of France and the United States syndicalism has built up a considerable following in Great Britain.

11. Gild-Socialism as a Compromise between Socialism and Syndicalism.— The movement generally known as gild-socialism means in its essence an economic decentralization and the solution of the labor problem through the revival of industrial associations like the mediæval gilds, adapted to the changed conditions of modern industrialism. Such a proposal dates back to the first half of the 19th century, when it was foreshadowed by some of the propositions of the English Christian Socialists and Ruskin. Especially congenial has gild-socialism been to modern Catholic social reformers, like Bishop Ketteler, Franz Hitze, Count de Mun and Hilaire Belloc. It also has been defended in a modified form by the French sociologist Émile Durkheim, while it has particularly attracted the younger British labor leaders, such as Mr. Cole and his associates. In its modern and elaborated form it aims to effect a reconciliation between state socialism and syndicalism. The political control and administration, which represents society as consumers and which receives the chief attention of the socialists, will be retained by the state. The management of industrial affairs, which pertains to society as producers and is represented by syndicalism, will be turned over to gilds or associations of workingmen, properly federated into national organizations. This will give essential industrial autonomy. Above both political and economic authority will be a joint-committee composed of representatives of the state and the gilds, which will have the final decision on disputed points and on those vital matters which concern the citizens as both producers and consumers. To many, gild-socialism seems the most promising of the modern reform policies and a clever synthesis of two of the most powerful of radical reform programs. Others, however, deny the possibility of any real separation of political and industrial functions. As Prof. Ernest Barker has expressed it, «any doctrine of separation of powers, such as Guild-Socialism advocates, is bound to collapse before the simple fact of the vital interdependence of all the activities of the 'great society' of to-day. Either the State must go, as Syndicalists seem to advocate, and that means chaos, or the State must remain — and then, if you are to have Socialism, it must be State-Socialism.»

12. Henry George, the Single Tax and Land Nationalization.— The great majority of radical reform programs in recent times have centred about attacks upon the methods of production and distribution of the earnings in manufacturing industry and commercial enterprises, but these ignored certain sources of modern social problems and evident causes of poverty and misery involved in the unequal and undemocratic methods of landholding. Therefore, it was natural that at least one important reform program should revolve about the proposal to reconstruct the methods of landholding to bring them more into harmony with modern democratic principles. The leader in this movement was a brilliant and energetic American, Henry George (1839–97). Living in California in the early days of its civic and industrial development he was struck with the great increase in land values that took place from purely social causes in less than a decade. Coming to New York the same phenomena attracted his attention in the extreme land values created by social and economic concentration on Manhattan Island. So forcibly was he struck by these facts that he came to regard this increase of real estate values and its absorption by private persons as the chief cause of poverty and misery. Consequently, he proposed, in his notable work on 'Progress and Poverty' (1879), the general abolition of other forms of revenue and the imposition of a so-called «single-tax» on land, which would turn into the public treasury the unearned or social increment in land values. This process would ultimately drive the landlord out of existence and pave the way for the democratic nationalization of land. George's theories attracted the greatest amount of interest in England where the evils he attacked were especially prevalent and where the Liberal party found a modified version of his doctrines a fine instrument to be used in attacking their traditional enemies — the Tory or Conservative landlords. Among his followers was the famous scientist, Alfred Russel Wallace, but it remained for David Lloyd George to give these doctrines some preliminary application in legislation. In the «small holdings Act» of 1907 and in his budget of 1909 he made a definite attack upon the vested landed interests. At the outbreak of the World War he was preparing a radical program of agrarian reform for Great Britain, but the close of the conflict found him detached from the reform party and sitting at the Peace Conference with two of the most tenacious adherents to agrarian autocracy in England, Arthur J. Balfour and Bonar Law. In the meantime the Bolshevik government in Russia had proceeded to carry through a plan of actual land nationalization, but it would seem that this was much more a product of the peculiar aims of the agrarian Socialist, or Social Revolutionary, party in Russia than it was of the direct adoption of the views of Henry George. Most progressive thinkers differ from Henry George primarily in holding that the single-tax should not be regarded as the sole remedy for modern social problems, though the majority of them would agree that society should in some manner absorb these socially created values known as the unearned increment, and all would give him credit for having called attention to the fact that the capitalistic manufacturer or merchant is not wholly responsible for the evils and misery of the present order. Much of the vitality of the single tax discussion has, however, been subsequently destroyed by changed economic conditions, particularly the relative decrease in the proportional importance of landed as compared with other forms of wealth, and the growing fluidity and legal elusiveness of the present modes of land-holding.

13. Bourgeois Attempts to Absorb the Radical Proletarian Movements.— It could scarcely be supposed that the middle class would sit by and idly contemplate the growth of these threatening proletarian programs and movements without attempting to counteract them — without trying, as one thinker has expressed it, «to set a backfire.» Probably the chief instrument which has been used has been state socialism or legislation designed to aid and placate the laboring class, while retaining the essence of the capitalistic system, though it must not be forgotten that much state socialism has been a result of proletarian or landlord attacks upon the middle class. The bourgeoisie have hoped to lead the proletariat to trust to the adequacy of the national capitalistic state as an agent for promoting the cause of social reform and the growth of industrial democracy. Further, the middle class has contributed great donations for social relief work and to aid modern scientific philanthropy, in the hope that such measures will both lessen misery, and hence the pressure for reform, and will attract the gratitude of those who receive aid. Such benefactions have not been made solely for the relief of physical privation and suffering, but even for the intellectual and recreational improvement of the lower classes through libraries, Y. M. C. A. organizations, playgrounds and parks. Then, the more progressive and far-sighted leaders of modern industrialism have developed policies of industrial conciliation designed either to placate the laborers or to get them practically interested in the preservation of the existing order. The best known of such methods are profit-sharing, co-operation, scientific management and industrial welfare work. Some have even gone so far as to foster the growth of conservative trade-unionism, such as is represented by the American Federation of Labor. Of course, many of the modern capitalists still hold tenaciously with strange fatuity to the attitude of John Bright and declare for a war to the end with state socialism and industrial democracy. This group can be trusted to decline with rapidity, or, if they show an unexpected tendency to increase, they may safely be left to the tender mercies of syndicalists and I. W. W.'s. Finally, a philosophy has been evolved designed to effect a liberal compromise between capitalism and labor, which has received its chief elaboration in France where it is generally spoken of as the doctrine of *solidarism*. It takes its origin from the doctrines of Comte, the Positivists and Leroux regarding the organic unity of human interests. It was further elaborated by the sociologists of the Organicist school and has recently been expanded by Léon Bourgeois from the legal point of view; by Charles Gide from the standpoint of the progressive economist; by Émile Durkheim as a profound sociologist interested in practical social reform; and very recently by the German, Nicolai, from a socio-biological point of approach. This doctrine aims at an honest and thoroughgoing attempt to reform the present order, so as to grant essential economic and social justice to the proletariat while retaining the undoubtedly superior directive and inventive ability of capitalistic enterprise. In its practical program it proposes, on the one hand, an extension of remedial social legislation through state socialism, and, on the other, a great extension of the principle of voluntary co-operation. Its adherents also generally incline toward some considerable decentralization of the administrative powers and functions of the modern national state. Some members of the group lean rather distinctly toward gild-socialism and the representation of economic groups and interests. All in all, it is the one program of reform which embraces the interests of both capitalists and proletariat and which is, at the same time, sufficiently honest, disinterested and progressive to entitle it to respectful consideration.

14. The Great War and Policies of Reconstruction.— The World War at some time in the future will probably be regarded by the historian as having constituted a crisis or a dividing line in the history of modern social reform movements, but it is too early to predict just what the nature of the succeeding reform movement will be. It will doubtless be seen by future historians that back of the struggle of nations was what may have been the beginning of the final struggle between the present social and economic classes — a struggle in which landlord and capitalist united against the common enemy in the proletariat. That the feudal landlord has generally succumbed in the course of the struggle, except in England, is generally conceded. That labor hoped for the equally decisive termination of the modern order of individualistic industrialism is apparent from what is usually taken as the most profound utterance of labor during the war — the report of the sub-committee of the British Labor party on reconstruction. "The individualist system of capitalist production, based on the private ownership and competitive administration of land and capital, with its reckless 'profiteering' and wage-slavery; with its glorification of the unhampered struggle for the means of life and its hypocritical pretense of the 'survival of the fittest'; with the monstrous inequality of circumstances which it produces and the degradation and brutalization, both moral and spiritual, resulting therefrom, may, we hope, indeed have received a death blow. With it must go the political system and ideas in which it naturally found expression." They expressed the further significant opinion that "what has to be reconstructed after the war is not this or that government department, or this or that piece of social machinery; but society itself." Further, during the struggle, as a result of the necessity of maintaining the production of necessary munitions at the highest level, abnormal concessions had to be made to labor, a situation which did not tend to make the proletariat particularly inclined to acquiesce in any later restoration of the social and economic *status quo ante bellum*. All countries were compelled to undertake what in times of peace would have been regarded as alarming steps toward complete state socialism. In Russia, the feudal autocracy was overthrown and there followed the first attempt in history to apply Marxian socialism to the reconstruction of a great state. In Germany, the fall of the Junker-Krupp alliance paved the way for the triumph of Revisionist socialism in the German political system.

The capitalists did not fail to recognize these various challenges to their very existence as a powerful organized class, nor did they hesitate to take steps to protect their system. Their most effective program was to make patriotism just as far as possible synonomous with rigid adherence to a belief in the sanctity of the capitalistic system and to brand all expressions of proletarian discontent and all plans for radical social reconstruction as products of disloyalty or vile enemy propaganda. Radical leaders were assassinated or sentenced to long terms of imprisonment for criticisms of administrative policy of a much milder character than were passed by unnoticed when uttered by political opponents who were members of capitalistic parties. Severe espionage laws were passed, which were little utilized to aid the military department, but were widely made use of to silence expressions of social and economic discontent. The close of the conflict left a serious situation — a proletariat determined to end an oppressive social and economic order and an organized effort of capitalists to preserve the system to which they owed their economic resources and political prestige. The solution of this problem is what now faces the world with the coming of peace and this solution is bound to be of infinitely greater significance for the history of modern civilization than the redistribution of national boundaries by the Peace Conference. Whether the adjustment will be made in a peaceful manner through a liberal compromise, in which both parties will concede much, or whether it will be made by violence in a bitter class war which cannot but end in the termination of capitalism in a most unfortunate manner, will depend wholly upon the sagacity and statesmanship of those who will lead in the negotiations. What plans of reconstruction will be most used cannot be foreseen. The problem has called forth a reconsideration of every one of the proposals of the 19th century which have been discussed above, not even excepting a return to the complete individualism of the economic liberals.

A final lesson regarding social reform programs has been taught by the World War and that is, as Professor Hobhouse pointed out a number of years ago in his 'Democracy and Reaction', that the state is bound to be obstructed in effective programs of social reform as long as militarism menaces our civilization. As long as citizens are bowed beneath the burdens of taxation to supply munitions for active warfare or to support vast armaments for "preparedness," there will never be adequate funds for thoroughgoing schemes of social reconstruction. A veritable social and economic paradise throughout the western world could have been created out of the funds expended in this war and in a very real sense the final solution of social problems is bound up with the discovery of some method for discouraging or eliminating war.

Bibliographic Note.— There is no adequate and complete bibliography on this subject, though J. B. Peixotto's ‘Syllabus of Social Reform Movements’ (University of California Press) and F. G. Peabody's ‘A Reader's Guide to Social Ethics and Allied Subjects’ contain a large number of classified titles. S. P. Orth's ‘Socialism and Democracy in Europe,’ pp. 273–279, contains a useful list of books. The bibliographies following chapters xviii and xxi of Volume II of C. J. H. Hayes' ‘Political and Social History of Europe,’ and the chapters of Parts III and IV of F. A. Ogg's ‘Economic Development of Modern Europe’ are full and up-to-date.

The clearest political history of modern Europe is C. D. Hazen's ‘Europe Since 1815.’ The political, economic and social background of modern social reform movements is set forth in C. J. H. Hayes' ‘Political and Social History of Modern Europe’; Robinson and Beard's ‘Development of Modern Europe’; J. S. Schapiro's ‘Modern and Contemporary European History’; F. A. Ogg's ‘Economic Development of Modern Europe’; and Max Farrand's ‘The Development of the United States.’

The proper intellectual orientation for a study of modern social reform is to be obtained from chapter ix of Volume I of Robinson and Beard, the last chapter of Volume II, and the concluding essay of J. H. Robinson's ‘The New History,’ on ‘The Spirit of Conservatism in the Light of History.’ The clearest elementary introductions to the subject are chapter xxi of Volume II of Hayes and the chapter in Schapiro on ‘Revolutionary Labor Movements.’ The following works would give a fairly complete account of all leading social reform programs: Gide and Rist's ‘History of Economic Doctrines’; Ogg's ‘Economic Development of Modern Europe’; Bertrand Russell's ‘Proposed Roads to Freedom,’ Part I; L. H. Haney's ‘History of Economic Thought’; S. P. Orth's ‘Socialism and Democracy in Europe’; E. Barker's ‘Political Thought in England from Spencer to the Present Day’; and F. S. Marvin's ‘The Century of Hope.’ The third volume of Professor Dunning's ‘History of Political Theories’ is in preparation.

The chief social reform programs down to the Industrial Revolution are to be found in W. W. Willoughby's ‘Political Theories of the Ancient World’; W. A. Dunning's ‘History of Political Theories,’ Volumes I and II; James Bonar's ‘Philosophy and Political Economy’; M. Beer, ‘The History of English Socialism’; W. B. Guthrie's ‘Socialism Before the French Revolution’; and J. B. Peixotto's ‘The French Revolution and Modern Socialism.’ The economic and social background of post-Industrial Revolution reform can be found in J. A. Hobson's ‘Evolution of Modern Capitalism’ and J. L. and B. Hammond's ‘The Village Labourer’; ‘The Town Labourer.’ On economic liberalism and utilitarianism good introductory treatments are to be found in Gide and Rist, Haney and W. L. Davidson, ‘Political Thought in England: the Utilitarians.’ On the economist's opposition to economic liberalism one should consult Haney and Gide and Rist; on the rise of Tory Socialism in England, Gibbins, H. D. B., ‘The English Social Reformers’ and Hutchins and Harrison, ‘The History of Factory Legislation’; on Christian Socialism, Flint, R., ‘The Philosophy of History in France’; Gibbins, and Seligman, E. R. A., ‘Owen and the Christian Socialists,’ in the ‘Political Science Quarterly,’ Volume I; on the literary and æsthetic revolt, Barker, chapter vii; on the utopian movement, Gide and Rist, Kirkup, T., ‘History of Socialism’; Noyes, J. H., ‘American Socialisms’; and Hinds, W. A., ‘American Communities’; on transitional socialism, Gide and Rist, Kirkup and Mariott, J. A. R., ‘The French Revolution of 1848 in Its Economic Aspects’; on the rise of modern anarchism, Brailsford, H. N., ‘Shelly, Godwin and Their Circle’; and Zenker, E. V., ‘Anarchism’; and on the political revolutions of 1848, Andrews, C. M., ‘Historical Development of Modern Europe,’ Volume I, chapters ix, x.

The nature of the German theory of the state is indicated in chapters i–iii of Barker and in John Dewey's ‘German Philosophy and Politics.’ The development of sociology is sketched in A. W. Small's ‘General Sociology’ and L. M. Bristol's ‘Social Adaptation.’ Marxian socialism is set forth in Spargo and Arner's ‘Elements of Socialism’; Gide and Rist; Kirkup; Russell, chapter i; and K. Kautsky's ‘The Social Revolution’; it is criticized by W. Sombart, ‘Socialism and the Social Movement’; and Skelton, O. D., ‘Socialism, a Critical Analysis.’ The Fabian movement and revisionism are discussed by Edward Pease, ‘The History of the Fabian Society’; and by E. Bernstein, ‘Evolutionary Socialism.’ State socialism is described by Ogg in Part III of his work; and in Hayes, ‘British Social Politics.’ Recent Christian Socialism is dealt with in F. S. Nitti's ‘Catholic Socialism’; C. D. Plater's ‘Catholic Social Work in Germany’; Cunningham, W., ‘Christianity and Social Questions’ and ‘Christianity and Politics’; Figgis, J. N., ‘Churches in the Modern State’. Recent anarchism is dealt with by Russell, chapter ii; by Zenker and by Eltzbacher, P., ‘Anarchism.’ Trades-unionism is well discussed in Webb, S., ‘History of Trade Unionism’ and in Orth. Syndicalism is analyzed by Russell, chapter iii, and by Levine, L., ‘The Revolutionary Labor Movement in France’ and Brissenden, P. F., ‘The I. W. W.: A Study in American Syndicalism’. Gild-socialism is treated by Cole, G. H. D., ‘The World of Labor’ and ‘Labor in Wartime’ and by Reckitt, M. B., ‘The Meaning of National Gilds.’ For the single tax program consult Henry George's ‘Progress and Poverty’ directly. Solidarism is analyzed by Gide and Rist. The problems of reconstruction are classified by Lindsey Rogers, ‘The Problems of Reconstruction.’ The problems connected with the ending of war are summarized in Duggan, S. P., ‘The League of Nations: The Principle and the Practice.’ From these introductory discussions the student will turn to the detailed monographs and the sources, many of which are mentioned in the bibliographies in Peixotto, Hayes, Ogg and Orth.

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SOCIAL SCIENCE, the science that deals with the social condition, the relation and institutions which are involved in man's existence and his well-being as a member of an organized community. It concerns itself more especially with questions relating to public health, education, labor, punishment of crime, reformation of criminals, pauperism and the like. Its history is traced in the most ancient of human records, in the sacred books and laws of Babylonia, Egypt, Judea and Greece. The universal concepts of modern social science as developed by Comte (q.v.), are found in Plato's 'Republic' and 'Laws'; in Aristotle's 'Politics'. It involves gathering of statistics, classifying them and drawing deductions, especially as to the larger question involved. It thus deals with the effect of existing social forces and their result on the general well-being of the community, without directly discussing or expounding the theories or examining the problems of sociology, of which it may be considered a branch. Its study is being taken up in schools for social workers, several of which have received grants from the Sage Foundation. Consult 'American Labor Year Book,' published by the Rand School of Social Science.

SOCIAL SCIENCE ASSOCIATION, American. A society organized for study and research in social problems, founded at Boston in 1865. Annual meetings are held in cities selected at the last preceding meeting. The work of the association is divided into five branches or especial fields as follows: Community health, education and art, social economy, finance and jurisprudence. The association has a membership of about 1,100, including the most eminent sociologists of America and other countries. Its official organ is the *Journal of Social Science*, published annually.

SOCIAL SCIENCE, National Association for the Promotion of, The (British), an organization founded in 1857 for the purpose of study and research in all matters of social service and industrial betterment. In 1864 it absorbed the Association for Promoting the Amendment of the Law. Yearly migratory meetings are held and transactions published. The society has greatly enlarged its scope from its foundation and now seeks to promote in Britain the initiation and development of the most beneficial and successful forms of social service.

SOCIAL SERVICE, the modern study of people and conditions looking toward the betterment of mankind; a forward movement dealing with life, occupations and environments, embracing the observation and investigation of the relations between employers and employees, co-operation, labor legislation, hours of work, wages, industrial betterment, child labor, factory sanitation and inspection, safety appliances, improvement of civic and municipal conditions, civil service, public ownership, the initiative and referendum, tax reform, marriage and divorce, housing, temperance, pauperism and crime, defective and delinquent children, education, social settlements, institutional churches and the like.

Social Revolutions.— During the 19th century there took place the two greatest revolutions in all history — one in the material world, created by the application of natural forces to industry; the other in the world of ideas, produced by the application of the scientific method to all processes of investigation. They have radically changed very many social conditions. Thousands of mechanics have lost their positions in recent years because they could not readjust themselves to the new methods of invention. Thousands of business men and manufacturers have been driven into bankruptcy because they could not adapt themselves to the new conditions by more economical methods of production and distribution. Many tens of thousands of men, women and children die needlessly in our cities every year because we have not yet learned how to adapt ourselves to the new conditions of urban life.

The process of readjustment is one of experiment. Each experiment, whether successful or otherwise, throws a ray of light on the problem of how to do it or how not to do it. Experience signifies nothing unless we trace the relations of cause and effect. The science of statistics, by which facts are so gathered as to embody truth and so interpreted as to afford knowledge, is of recent origin. It is a singular fact that our young republic was the first government in the world to take a census at stated intervals. Ships of state kept no log-books. It is small wonder that so many split on the same rocks. Important as it is in social and political science to know precisely where we are, it is even more important to know the direction in which we are moving, for tendency is prophetic, and to establish a line of tendency we must fix more than one point; hence the value of a base line. Our decennial census during the 19th century established a base line 100 years long — the first in all history — from which we may measure in the 20th and in each succeeding century. Only in recent years have men learned to gather facts, to sift them and correctly to interpret them, thus creating science. We are only beginning to construct the science of living, which is living in intelligent obedience to all natural laws; that is, all the laws which God has established both for the individual and for society.

Existing Evils.— There are many great evils incident to our present stage of industrial and social evolution on which no intelligent lover of his country and his kind can look with indifference. The widespread hostility, if not open conflict, between organized capital and organized labor does violence to economic and social laws no less than to Christian principles. The reckless and increasing sacrifice of life and limb in American industry calls for such education of public opinion as will demand and enforce effective legislation touching accidents and their prevention. The victories of peace are even more bloody than those of war. There were not so many victims of the Boer War as there were in American industries during the same period. If to casualties on railroads we could add those in the mining, manufacturing, building and lumber industries, the totals would show a very considerable industrial army killed and a very large industrial army wounded every year.

Our Western industrial progress is attended by considerable evils. It redistributes populations, compacting masses in the city, creating the tenement-house with its long list of evils, complicating the problems of sanitation and raising the death rate. It assumes the rôle of Herod and slaughters the innocents, while the children who escape from the factory with their lives are commonly pinched and deformed in body and mind. It creates the popular discontent which inevitably springs from the multiplication and popularization of knowledge together with the multiplication and concentration of wealth. It is attended by the organization of capital and labor which are arrayed against each other in hostile camps. Now many of these evils are entirely preventable, though certain to be developed if neglected. They were permitted to fasten themselves on western Europe and the United States because they were not foreseen. That excuse does not exist for the remainder of the world. With the close of the World War and release of shipping, northern capital, population and energy will flow into South America and inaugurate there an industrial revolution. It is already well under way in Russia and Japan and is now beginning in China and India. Unless prevented by intelligent foresight, the evils which have thus far attended the industrial revolution will accompany it round the world and involve the hundreds of millions of these countries in sufferings as measureless as they will be needless. These peoples are credited with less power of self-restraint than the peoples of Europe and North America and yet we are in a World War, based on a desire for industrial supremacy. We are, therefore, bound by every obligation of humanity and religion to safeguard them with our experience and thus forestall preventable evils, which if not thus prevented will be far more disastrous in the Orient than they have been in the Occident.

Many organizations exist for improving conditions in large cities. These organizations need to know each others' methods and to work together. To that end, a National Community Centre Conference is now held annually in the United States, the 1917 gathering in April being attended by delegates from 26 cities.

The Musée Social.— The section of Social Economy in the Paris Exposition of 1889 was peculiarly rich in documents relating to the conditions of labor and to workingmen's institutions. This exhibit made permanent was the origin of the Musée Social. Endowed with adequate funds, it is devoted solely to the promotion of the study of labor problems and the advancement of concrete measures of labor reform. As regards its organization and purpose it exemplifies in the field of economic research very much what the Smithsonian Institution in Washington does in the domain of scientific investigation. Both were founded by private individuals "for the diffusion of knowledge among mankind." Both are non-scholastic in the sense of having no regular classes of students and both maintain a corps of experts devoted to original research and to the aid of those making similar inquiries. The Musée constitutes a veritable laboratory for economic research in all fields as far as they relate to concrete labor problems. In the language of its constitution, its object is "to place gratuitously at the disposition of the public documents with collateral information, constitutions and models of institutions and undertakings having for their aim the improvement of the moral and material situation of the laboring classes." To carry out this aim the Musée has spared neither pains nor expense in the organization of every possible means of obtaining information concerning labor and labor conditions in all lands and in facilitating its use by all those interested in matters of social reform. It is well installed in a building owned by it at 5 Rue Las Cases, where it has lecture-rooms, meeting-rooms for the economic and reform societies of Paris, exhibition-rooms for the display of plans, models and accident-preventing appliances and its carefully selected library. This includes over 15,000 volumes exclusively devoted to labor and consisting largely of original sources of information, reports and proceedings of societies and social undertakings which are not to be found in ordinary libraries. Its files include records and copies of labor legislation in all countries and of important labor events, catalogued and under the direction of skilled librarians, whose duty it is to help investigators desiring to make use of such material. The Musée, however, is not content with bringing together the results of others' efforts. Each year it sends one or more commissions to investigate particular features of the labor problem in foreign countries. It has thus made detailed investigations of trade unions in Great Britain, labor organizations in the United States, co-operative and credit institutions in Italy and the agrarian question in Germany by special delegates sent to those countries. In addition to making these special inquiries, it maintains in foreign countries special correspondents whose duties are to supply the Musée with copies of all bills, reports or laws concerning labor matters presented in their respective countries or of privately published works concerning labor, to furnish information as called for and to transmit annual reports giving a résumé, with documents, of the labor events, legislation and judicial decisions relating to labor during the year. See SOCIAL AND UNIVERSITY SETTLEMENTS.

SOCIAL SERVICE, American Institute of. The League for Social Service of New York City was organized in New York in 1898 by Josiah Strong and William H. Tolman, who became its president and secretary, respectively. The League, reorganized, enlarged and incorporated, became known in 1902 as the American Institute of Social Service, with headquarters at 287 Fourth avenue, New York. The three functions of the Institute are: (1) To gather from all possible sources facts of every kind which bear on social and industrial betterment. (2) To interpret these facts by ascertaining their causes and effects, thus gaining their real significance and (3) to disseminate the resulting knowledge for the education of public opinion, with an educational charter from the Regents of the University of the State of New York.

The work of the Institute is divided into 11 departments: (1) Bureau of Information; (2) Investigation; (3) Illustration; (4) Publication; (5) Legislation; (6) Lecture Bureau; (7) Library and Archives; (8) Museum of Security; (9) Personal Study and Research;

(10) International Relations; (11) Relations with other Societies.

The American Institute of Social Service is collecting a great mass of facts from Europe, as well as America, which embody experiences of many millions of people, and these facts scientifically interpreted throw light on many social problems, new and old, and afford practical guidance in the conduct of life and in the establishment of right relations between man and man. In response to inquiries, the Institute's bureau of information is constantly sending materials bearing on social and industrial betterment to newspaper men, ministers, students, teachers, authors, legislators and the like. When a corporation desires to improve the condition of its employees, the Institute can furnish facts and photographs showing what is being done along these lines by many of the world's great captains of industry, such as Casimir-Perier of France, Van Marken of Holland, Cadbury of Birmingham and Lever of Liverpool, describing their improved housing, their sanitation, their hospitals, homes for convalescents, schools, kindergartens, athletic grounds, parks, baths, swimming pools, systems of insurance, old-age pensions and the like. Again, a city desires to improve its municipal housekeeping and would like to learn from Glasgow as a model. It is not necessary for Cincinnati or Chicago to send a committee of investigation to the Scotch metropolis. The Institute can send Glasgow to Cincinnati or Chicago and by means of hundreds of lantern slides show her improved tenements, her street-cleaning system, her playgrounds, her out-of-door gymnasia, her hospitals, her park system, etc. A church which is struggling to adapt itself to a changed environment wishes to know how certain problems have been solved. The Institute can give information of scores of churches which have successfully adjusted themselves to new conditions and whose experience will probably afford the desired solution. The existence of all the States with their separate legislatures affords a vast field for social service by helping all to profit by the experience of each. Most of the great problems of all the States are substantially the same, as in the case of pauperism, crime, defective and delinquent children, the relation of labor and capital and the like. Some States are much in advance in one particular, others in another. What if, in each particular, all the States could be brought up to the standard of the most advanced State; how would the nation leap forward in civilization? For instance, the experience of several States has demonstrated the value of juvenile courts and of industrial legislation for children. In the natural course of things it takes years for such reforms to reach the more backward States; whereas the Institute, with the necessary funds, could doubtless educate public opinion so as to secure the desired legislation in one-quarter of the time. As President Roosevelt says in a letter to the Institute: «The possibilities of the Institute are well nigh boundless. It is apparently proving to be the beginning of a world movement, and is being recognized by the best men of many different countries as a necessity in each and all of these countries in order to facilitate a readjustment of social relations to the new conditions created by the modern industrial revolution.»

In 1903, Andrew Carnegie (q.v.), the philanthropist, placed in trust the sum of $2,500,000 for the purpose of beautifying and improving his native town of Dunfermline, Scotland, and the American Institute of Social Service outlined a plan of procedure for this important work. The plan included a regional museum, a district for a «city beautiful,» a social centre, a department of civics, boys' and girls' flower gardens, children's playgrounds and out-door gymnasia, holiday tours and historic pilgrimages, «get-together club» and a system of awards and prizes. The general outline for a city beautiful suggests that somewhere in the confines of the park land should be set aside on which can be built model dwellings of diversified architecture. One house should be set aside as a working model, furnished throughout with all necessaries and as many comforts as are demanded by a modest taste. By means of this model house, clerks, artisans and laborers may be shown how to furnish their homes. Under this plan the social centre should be a building located in the park, easily accessible, so as to be a resort for all the people — children for the most part by day, adults at night and on holidays. It should contain a hall for music, speaking, dancing, flower shows and other entertainments. There should be classrooms for instruction in music and art in its various branches. In a regional museum should be collected the various processes of local industries, in order that the individual workman may get an idea how his part in the process is related to the great industry as a whole. The department of civics is intended to inspire youth and to direct their enthusiasm wisely, so as to raise the tone of their citizenship. Consult Ogburn, W. F., 'Wages in American Cities' (1917); Calhoun, A. W., 'Social History of the American Family' (1917).

SOCIAL SETTLEMENTS. See SOCIAL AND UNIVERSITY SETTLEMENTS.

SOCIAL AND UNIVERSITY SETTLEMENTS. Social service is the modern study of people and conditions looking toward the betterment of mankind; a forward movement dealing with life, occupation and environments, embracing the observation and investigation of the relations between employers and employees, co-operation, labor legislation, hours of work, wages, industrial betterment, child labor, factory sanitation and inspection, safety appliances, improvement of civic and municipal conditions, civil service, public ownership, the initiative and referendum, tax reform, marriage and divorce, housing, temperance, pauperism and crime, defective and delinquent children, education, institutional churches and the like. The houses or buildings whence all these activities are directed are known as social settlements and the fact that university men were and are prominent in the movement has caused them to be known frequently as university settlements.

The necessity for systematized social service was impressed originally upon the minds of Englishmen, due to the enormous increase in the indigent and submerged class in London and in other large cities of Great Britain, which became apparent soon after the great expansion of the factory system there in the first half of the 19th century. It was realized that useful aid along a variety of lines could be best given by men and women actually living among the poor and studying the difficulties besetting them. Among the prominent leaders of the movement in England were Arnold Toynbee, Charles Kingsley, John Ruskin, Thomas Hughes, Dickens, Carlyle, Thomas Arnold, Thomas Hill Green and Edward Dennison. A growing sense of social duty and responsibility actuated these men in calling attention to the many social evils of their period. In 1864 Dennison went to London to live in a poor quarter of the East End. In 1871 Arnold Toynbee gave several addresses before the workingmen's organizations in London and in the provinces. He died in 1883 while still in early manhood. It was Toynbee's spirit and ideas more than any work which he individually accomplished that gave to the settlement movement its chief characteristics and its abiding sense of social obligation. The work as taken up by Canon Barnett and others imbued with Toynbee's spirit assumed three general forms: (1) Relief through charity and medical attendance; (2) the providing of opportunities of a social and recreative character; (3) the establishment of educational centres for purposes of primary or advanced instruction, including certain phases of culture. In 1860 F. D. Morris established the Workingman's College in London. In 1867 Cambridge University started its first University Extension scheme. Following this, in 1869, the Charity Organization Society was founded; in 1885 Toynbee Hall was opened by Barnett in East London and in 1887 the Neighborhood Guild, later the University Settlement, was opened in New York City. These initiatory steps were followed by others of a closely allied character in all large cities where the density of population is sufficient to indicate the need for social service.

The dominant idea in settlement work is that of teaching wage-earners to help themselves. The goal sought is individual development stimulated into being under the guidance of teachers. The element to be eliminated in all these efforts is that of patronage. Social service in the nature of direct gifts of food, fuel, clothing or money must be extended with great discrimination, lest chronic pauperism be encouraged and the already too large class of parasites on the charitable world be increased. In all phases of the work, tact and judgment are required, but these are particularly requisite in dealing with those cases where pride prevents an advertisement of need or forbids the acceptance of unsolicited help. Persons possessed of these qualities and who are capable of advising and preventing the development of acute conditions in particular cases are of the greatest value in settlement work.

Nature of Settlement Activties.— The work at a centre is laid out into six classes: (1) care of infants; (2) courses for children from six to 14 years of age; (3) course for boys and girls between 14 and 18 years; (4) a course for women of more than 18 years; (5) a course for men of 18 years and upward; and (6) general courses of an advanced nature. In connection with talks to mothers, ocular demonstrations of the best care of infants and young children are given. Children fit for kindergarten work receive the benefit of æsthetic culture through colored paper work, music, songs, parties, games, plays, etc. The older children of from six to 14, through physical culture classes, are given opportunities for improving their general health; they are formed into clubs for the purpose of developing administrative ideals, and encouraging self-help. Their work consists of drawing, sewing, mending, wood-carving, cooking, nature study, musical classes, chorus work, including entertainments, art exhibits, summer outings, picnics, winter socials and receptions. A late development is the teaching of dancing, which is found to be a most admirable means for the development of grace of body and the power of acting in concert. Those of 18 years and upward follow a scheme which includes the preservation of health, study and training along technical lines, forms of instruction in classes, lectures, concerts, and various aids to culture, sociability and political breadth of mind. The idea running current through all these courses, designed as they are to meet the requirements of the child, the youth and the adult, is that of inculcating the value of physical health, wage-earning and other concomitants of economic welfare, general instruction, an insight into the meaning of æsthetic culture, the value of functions which increase sociability, the advantages of clubs and discussions for the purpose of gaining political and other co-operation, and other means of creating a sense of "community interest" and good citizenship.

Social Service to the Immigrant.— While in the older nations the class among which these activities are exercised is made up of natives, the "submerged tenth" of London, for instance; in America, it is the new-comer, the first generation of the immigrant horde and its children, that call for the labor of the social service workers, and the work required is the adjustment of the lives of these people to their new environment, and especially in giving to the older ones a sense of nationality and citizenship and a knowledge of the power this gives them. When they fully realize that they can, if they will, choose representatives to properly present their needs, an immense gain is made, and the feeling of class against class, and a belief in dominance of wealth in the government, ideas only too prevalent and not wholly without foundation, will be in a fair way of disappearing. To awaken within the immigrant a consciousness of his power is a moral, as well as an economic necessity, for social demoralization disappears before healthy mental activity.

The religious question is delicate only when misunderstandings arise; if the expressed object of a centre is to impart religious or ethical principles, a frank acknowledgment is proper. Some settlements operate along definite denominational lines, so that no misapprehension arise even when proselyting results. Ambiguity in this respect is an injury to the cause.

Administration of Settlements.—A head-worker is the chief of a staff of assistants which are divided into two classes; the first and most important class are the resident workers. The second class are non-resident workers. The head-worker's duty is that of giving intelligent advice to his assistants, when they are in doubt as to what course to pursue. The workers in all cases are allowed considerable latitude as to ways and means of obtaining practical results, but no effort must be spared to avoid friction and to produce an absolute harmony in all parts of the work.

For the proper administration of activities centred in a settlement, money must be forthcoming; though the city itself is the direct benefactor, it is never the main contributor. The workers must be sufficiently well paid to enable them to live decently while devoting their time to the work. To the non-resident workers no remuneration is given. It is then a necessary part of the work to secure money when there is not a regular income provided by endowment or contributions. As far as possible the idea of self-support is advanced in all phases of settlement work. The head-worker and his assistants plan along economic as well as cultural lines. A head-worker of strong personality and broad mentality with experience and judgment is necessary as supervisor and manager. Diplomacy is a great requisite, particularly in the encouragement of those willing to sacrifice time and labor for humanity's sake, as resident or non-resident workers.

Development of the Settlement Idea.— From Toynbee Hall in 1885 the settlement idea spread out through the larger centres of population in England until to-day there are about 50 such in the country. In America the Neighborhood Guild of New York was followed soon after by the "College Settlement" and in 1889 Chicago saw the establishment of Hull House, the greatest American settlement. In America there are at present over 100 settlements doing excellent work in the congested areas of the large cities. The *Université Populaire* and the *Œuvre de Popincourt* in Paris are similar in their educational work to the university settlements. The *Ouis Huis* of Amsterdam, Holland, is also similar. There is a missionary settlement in Bombay, the "House of Neighborly Love" in Kioto, Japan, and Kingsley Hall and a French missionary settlement in Tokio. The movement has spread to Australia, the Toynbee Guild at Sydney being founded by an Oxford man. In America and to a greater extent elsewhere social settlement work can ever be but a palliative in that the fundamental causes of poverty, low wages, etc., are left untouched by the movement. Young college men and women of humanitarian views spend a few years in the work after graduation but leave it for a real career just when their experience would render them valuable aides in the work. By some it is used as a means to acquire the necessary experience in order to qualify for a position in the correctional or charitable administration of the State. The recent campaign for Americanization in the United States takes up the work of the social settlement as far as regards the preparation of the foreigner within our shores for citizenship. Even here the motive has not been entirely altruistic nor patriotic but rather the effect of conservatives to stave off the introduction of governmental principles which to them seem subversive of the present order. A campaign to teach common honesty and fair dealing in the affairs of life especially among our men of wealth is more needed in America to-day than any campaign against radical movements, which can never gain a real foothold in our democratic system.

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SOCIAL WAR (Lat. *Bellum Sociale*), or **MARSIC WAR**, a war waged in 90–88 B.C., between Rome and her allies of southern and central Italy, including the Marsi, Peligini, Samnites and Lucanians, precipitated by Rome's refusal to extend to them the privileges of Roman citizenship. A new Italian republic was established with its capital at Corfinium and its leaders waged successful war against the Roman forces under the generals Marius and Sulla. Rome, however, encompassed the fall of the republic by granting the formerly withheld rights as citizens in return for allegiance to the empire. In Greek history there were two Social Wars. (1) In 357 or 358 to 355 B.C. between Athens and her former allies, Cos, Chios, Rhodes and Byzantium. Athens suffered defeat. (2) In 220–217 B.C. between the Achæan and Aetolian leagues.

SOCIALISM is a word having two distinct but related meanings: primarily it is used as the name of a certain philosophy of history and method of interpreting and analyzing social phenomena. In the second place, since this philosophy and method have as one of their principal conclusions that society is evolving toward a co-operative social stage, the word is used to designate a co-operative social organization where the means for the production and distribution of wealth are the collective property of the working class, while the goods which are to be consumed become the private property of the individual workers. The philosophy of Socialism, as generally accepted by the socialist parties of the world at the present time, takes as its fundamental hypothesis what has been variously called the materialistic interpretation of history, historic materialism, or economic determinism. This doctrine is stated as follows in the introduction to the 'Communist Manifesto':

> "In every historical epoch the prevailing mode of economic production and exchange, and the social organization necessarily following from it, form the basis upon which is built up, and from which alone can be explained, the political

and intellectual history of that epoch; and consequently the whole history of mankind since the dissolution of primitive tribal society, holding land in common ownership, has been a history of class struggles, contests between exploiting and exploited, ruling and oppressed classes; the history of these class struggles forms a series of evolution; now-a-days, a stage has been reached where the exploited and oppressed class — the proletariat — cannot attain its emancipation from the sway of the exploiting and ruling class — the bourgeoisie — without at the same time, and once and for all, emancipating society at large from all exploitation, oppression, class-distinctions, and class-struggles."

It is maintained that the form in which production is carried on in any society constitutes the fundamental fact which determines all other social institutions. This does not hold that each economic era begins *tabula rasa* in the field of institutions. Each historical stage inherits its institutions from the previous stage and it can influence, change and reconstruct these or establish new ones alongside of them. These inherited characteristics include customs, laws, ethical standards, public opinion, and in short the whole set of institutions and social psychology which has been built up throughout the course of human evolution. The analogy between heredity and environment in biology and in the social organism is here very close. Since the appearance of the institution of private property in the instruments by which wealth is produced and distributed, society has necessarily been divided into two classes according as their members own or do not own these essential for the production of wealth. The struggle of these classes for power constitutes a large portion of the history of modern times. In the Middle Ages, land being the most essential instrument for the production of wealth, the landlords were the ruling class and social institutions were determined by them in accordance with their interests. When the great transformation of hand tools into factory machinery took place at the close of the 18th and beginning of the 19th century, this machinery of the modern factory became the most essential element in the production of wealth, and its owners became the ruling class.

When the owners of industrial capital had gained their victory they set about establishing a society in accordance with their interests. They formed at this time the class most necessary to the basic industrial processes of society, since the accumulation and organization of capital was the most essential thing at this historical period. Later on the capitalist class laid down its function as organizer and director of industry and became simply a share-holding class. Hired wage-workers, including manual laborers, overseers, bosses and superintendents perform all the essential social processes. The capitalist class having handed over its function to the working class, the latter becomes not only the most essential, but the only essential class. The material interests of this class involve it in continuous struggles with the capitalists. Sooner or later this struggle is transferred to the political field where the laboring class is represented by the Socialist party, having as its object the capture of the powers of government and social control in order that it may use them in the interest of that class.

According to this philosophy the social dynamic which compels advance is the continuous improvement of the processes of production. Every new invention and every improvement in the organization of industry starts in motion a series of influences which do not cease until they have reached and affected every institution within the society of which they form the industrial basis. During the last 100 years mechanical improvements have multiplied many fold the productive power of each individual worker. But the army of unemployed prevent the price of labor power as a whole from rising much above the point necessary to maintain the efficiency of the wage-worker as a producer. Consequently the workers who use these improved instruments receive but a small fraction of the greatly multiplied product. They have no choice under the present system but to accept these conditions. While production is for sale in the competitive market only the cheapest can continue to produce. If the workers are to produce, and they cannot live without producing, since they have no power of ownership to take from other producers, they must gain access to these highly perfected tools. Hence they compete with one another for the privilege of using them, and of selling their labor-power to the owners of the tools. They finally accept a wage-contract by which, for the privilege of producing their own wages during the first hour or two of work, they continue at work for many hours more, producing surplus value for the owner of the means of production which they use.

Improvements in production often take other than mechanical forms. The modern trust is, to some extent, to be considered as such an improvement. Socialist writers pointed out over a half century ago the self-destructive character of competition. It was then foreseen that one of the inherent characteristics of large industry was its greater economy as compared with smaller competitors. Consequently the large industry tended to eliminate all smaller competitors within the circle of its market. Improvements in transportation, communication and storage rapidly extended the circle of the market to national, and for some products, at least, to international dimensions. When, however, there are sufficient plants constructed to more than supply any circle of the market and competition is reduced to a few industrial units, the wastes of competition and the destructiveness of competitive war become so evident that combination is inevitable. The result is some one of the various forms of combination by which competition is stifled and monopoly established.

The wage-workers seek political victory in order that they may impress their interests upon the social organism and thereby remove the evils under which they suffer at the present time. Since most of the evils of which they complain spring from the fact that they are debarred from access to natural resources and the instruments for the production and distribution of wealth, their first demand is that such access be freely granted. But free access implies legal ownership and with modern concentrated complex industry this ownership cannot be individual unless all the evils of the present system are retained. Hence, we have a demand for collective ownership.

Thus Socialism as a philosophy is mainly an analysis of capitalism. As an ideal, as a social stage, it presupposes the capitalist system, since that can alone prepare the way for Socialism.

This future system, or ideal, is in no sense of the word a scheme whose adoption is asked for by the Socialists. It is simply the next logical stage in social evolution. Socialists do not attempt, therefore, to give any details of that future society since all such details will be dependent upon the decision of a majority of the working class of that future time, and upon the stage of industrial development which has been attained when Socialism is ushered in. Since both of these factors are manifestly impossible of being known at the present time, any attempt to forecast their outcome would be equally impossible. All that can be said is that present tendencies of social development show what must be a few of the general features of the next social stage.

Socialists maintain that the coming society will be preferable to the present one, especially for the working class. With a collective democratically managed organization of industry, in which natural resources and the mechanical means for the production and distribution of wealth have their ownership vested in society, and where production is for the direct use of the producers and not for sale, the wastes of the present system will be largely abolished. Among these wastes which will be abolished are advertising, duplication of plants and power, poor utilization of mechanical progress, disadvantageous geographical location of industries, etc. Some of these are already being abolished by the trust method of production. But at the present time the saving accomplished redounds almost wholly to the benefit of the few owners of the trustified industry. In addition to this, Socialists maintain that much greater savings would be made under Socialism by the utilization in productive labor of the energies of whole classes of the population from whose strength and ability society, at present, derives little or no advantage. This would be true, for example, not alone of the present army of the unemployed amounting in the United States to between 1,000,000 and 3,000,000, according to industrial conditions, but also the purely capitalist class whose functions of ownership being performed collectively would enable the members of that class to directly assist in production. By far the larger share of that portion of the population concerned in the protection of individual property rights in what Socialism would make collective property, such as lawyers, judges, police, private watchmen, detectives and the army and navy, could also be changed into productive workers.

Socialists also claim that in a co-operative society the sum total of human happiness would be immensely increased by making the production of goods in itself pleasurable. When profit and the competitive struggle are abolished and productive energies fully utilized there will be a possibility of that leisurely artistic creative activity, which modern psychology and pedagogy agree is capable of furnishing the most intense pleasure and valuable educational training to the individual worker while, at the same time, producing the best possible goods for the satisfaction of human needs. It is this phase of Socialism which has always attracted artists and has given rise to the now extensive arts and crafts movement. It is easy to see in this connection that Socialism would offer a much greater field for the development of individuality than is possible for the great mass of the people to-day.

The theory of Socialism is itself a product of evolution, the ideal appearing long before the philosophy of society and the scientific analysis of social relations which make possible the realization of that ideal were worked out. Ever since the days of Plato, and especially since the writing of Sir Thomas More's 'Utopia,' men have dreamed of a society which should be a co-operative brotherhood. During the latter part of the 18th and first half of the 19th century, utopian Socialism reached a high degree of development and found numerous illustrious followers. Among these were Fourier, Babœuf, Saint Simon and Cabet in Europe, and a few years later, Greeley, Dana and Nathaniel Hawthorne in America. Robert Owen marked somewhat of an advance on this position. While he founded colonies and pictured utopias, he also set forth many ideas that have since become a part of modern scientific socialism. Lassalle, Rodbertus and Weitling in Germany, Colins and De Paepe in Belgium also helped to some degree to formulate present socialist philosophy while they also partook of a Utopian character. It is with the work of Karl Marx (q.v.) and Friedrich Engels (q.v.), however, that modern Socialism began definitely to take on the forms by which it is known to-day. In 1845 Marx was ordered out of Paris and went to Brussels where he was joined by Engels and where they founded the «German Working-Men's Association» with the *Deutsche Brüsseler Zeitung* as its organ. It was while here that they became members of the Communist League and wrote the 'Communist Manifesto,' to which reference was previously made.

A philosophical and a political goal presupposes an organization for propaganda and political activity. The body that is generally looked upon as the ancestor of the present world-wide Socialist organizations is «The League of the Just,» organized in Paris in 1836. The aims of this organization were, however, very indefinite, and its principal significance lies in its transformation in 1847 into the «Communist League.» This change was brought about through the influence of Marx and Engels. While the «Communist League» exercised considerable influence on Continental labor movements during the first two or three years of its existence, yet it was overwhelmed in the reaction which followed the revolutions of 1848, and by 1853 it had practically disappeared. Its great contribution to Socialism lies in the fact that under its auspices was issued a document that for far-reaching consequences and lasting influence must be considered one of the most remarkable ever written. This was the 'Communist Manifesto' drawn up by Marx and Engels as a committee of the Communist League in 1848. This work consists of a summary of the philosophy of Socialism and has been translated into almost every known language, and still constitutes the most generally circulated work on Socialism in existence. New editions and translations appear continually throughout the world. The next great step was the organization of the International Working-Men's Association (q.v.) at Saint Martin's Hall, London, 8 Sept. 1864. A committee appointed at this meeting and composed of 50 members representing six nationalities presented a declaration of principles which was written by Karl Marx and which was unanimously accepted by the organization. Since this declaration has formed the basis of almost countless socialist platforms in different countries since that time it is worth reproduction:

> " In consideration that the emancipation of the working class must be accomplished by the working class itself, that the struggle for the emancipation of the working class does not signify a struggle for class privileges and monopolies, but for equal rights and duties, and the abolition of class rule;
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> That the economic dependence of the working man upon the owner of the tools of production, the sources of life, forms the basis of every kind of servitude, of social misery, of spiritual degradation, and political dependence;
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> That, therefore, the economic emancipation of the working class is the great end to which every political movement must be subordinated as a simple auxiliary;
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> That all exertions which, up to this time, have been directed toward the attainment of this end have failed on account of the want of solidarity between the various branches of labor in every land, and by reason of the absence of a brotherly bond of unity between the working classes of different countries;
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> That the emancipation of labor is neither a local nor a national, but a social problem, which embraces all countries in which modern society exists, and whose solution depends upon the practical and theoretical co-öperation of the most advanced countries;
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> That the present awakening of the working class in the industrial countries of Europe gives occasion for a new hope, but at the same time contains a solemn warning not to fall back into old errors, and demands an immediate union of the movements not yet united;
>
> The First International Labor Congress declares that the International Working Men's Association, and all societies and individualities belonging to it, recognize truth, right and morality as the basis of their conduct toward one another and their fellow men, without respect to color, creed, or nationality. This Congress regards it as the duty of man to demand the rights of a man and citizen, not only for himself, but for every one who does his duty. No rights without duties; no duties without rights."

At the last European meeting of the «International,» anarchistic forces under the leadership of Bakounin threatened to gain control, and in order to avoid this catastrophe the Socialists who were still in the majority voted to remove the headquarters of the organization from London to New York. There was another purpose in this also. It was felt by Marx and others that since the doctrines of Socialism had been included in various national working-men's movements and had been somewhat systematized by the discussions of the congress, that the time for a great centralized organization was past, and that its disappearance would be the best thing possible.

The next 20 years saw the growth of powerful national Socialist movements, but with no centralized international organization. At the end of that period these parties felt the need of some sort of co-operation and united in the first of a series of International Congresses at Paris, 14 July 1889. The new international was a creation of the national bodies and not a centralized organization having control of branches in various nations. At this first meeting differences developed so great that two congresses instead of one were held, although some of the delegates participated in the meetings of both bodies. Two years later, at the Congress of Brussels this breach was at least partially healed and it gradually disappeared. In 1896 the old conflict with anarchistic elements arose but was settled by the adoption of a resolution excluding from subsequent congresses those who repudiate political action. The Congress of Paris, 1900, laid the foundation of a new permanent international Socialist organization by the formation of the International Socialist Bureau. This bureau is composed of permanent delegates from each country, the larger nations electing two and the smaller one. A chairman and secretary were also elected and Brussels chosen as the seat of the international secretariat. With the outbreak of the European War in 1914 Socialism attracted more general attention than at any previous time in its history. Many people had hoped that by concerted action the Socialists of Germany would be able to prevent that country's entering the war. Soon after the declaration of war it was found that practically all of the Socialist parties in the warring countries had cast in their lot with their governments. For 50 years before the war Socialist congresses and Socialist periodicals had discussed the problem of war from every possible standpoint and recognized it and the hostile feeling between nations as the greatest obstacles to the development of a world-wide social democracy. The causes of modern wars, according to a leading American Socialist, are as follows: «The basic cause is capitalism; the contributory causes are imperialism, militarism, social unrest, international grudges and pseudo-patriotism.» In 1907 the International Socialist Congress was held at Stuttgart and is memorable for the anti-war resolution passed after considerable discussion between Bebel, Jaures, Vandervelde and others. The terms of this resolution named capitalism as the cause of war and stated that the workers of the world are the natural enemies of war. An additional formulation, proposed by Rosa Luxemburg, Lenine and Martoff, is illuminating, in view of subsequent events. It is as follows: «In case a war should, nevertheless, break out, the Socialists shall take measures to bring about its early termination and strive with all their power to use the economic and political crises created by the war to arouse the masses politically and hasten the overthrow of capitalist class rule.» This threat was incorporated in the Stuttgart resolution and was adopted at the Congress of Basel in 1912. Among the means proposed to avert war were a general international strike, the refusal of money for military supplies and a general anti-military agitation. The International Congress of Copenhagen in 1910 modified somewhat the proposals of previous congresses and was undoubtedly less anti-militaristic than its predecessors. An international congress was to meet in Vienna in August 1914 but the outbreak of hostilities prevented its convening. The International Socialist Bureau, with headquarters at Brussels, suspended its activities in July 1914. Vandervelde, chairman of the bureau, became a member of the Belgian government and the bureau was removed to The Hague. Here a conference of Socialists from neutral states (Denmark, Sweden, Holland, Argentina and the United States) was held on 30 July and 1 and 2 Aug. 1914. It passed resolutions blaming capitalism for the war and advocated free trade and a democratization of power. Socialists from the belligerent countries met for the first time at the Zimmermann (Switzerland) Congress in September 1915. The same representatives met at Kienthal 24-30 April 1916. Much opposition and factionalism followed the proposal to renew the International and to attempt a discussion of the peace problem, in which the German delegates would take part. In 1917 leading Socialists of the world proposed a peace congress to be held at Stockholm. The movement was initiated by the Russian Council of Workmen's and Soldiers' delegates. Immediately the Austrian and German Socialists drew up a peace program in which the main points were «No annexations, no indemnities.» Much discussion ensued in the Entente countries relative to the granting of passports to delegates to the Stockholm conference. Ultimately passports were refused delegates in France, Great Britain, Italy and the United States. The Stockholm Conference was consequently not fully representative and while it did not succeed in its peace program, it certainly gave an impulse to the pacifist movement in the warring countries. The progress of the war and its conclusion gave a great impetus to Socialism, which spread more rapidly than ever before and came into power in several of the larger countries of Europe.

Germany.— Germany for a long time led the Socialist movement of the world in the number of votes, representatives in Parliament, press and literature. On the theoretical side German Socialist thought has often been traced back to Hegel and Fichte. Winkelblech, better known as «Karl Marlo,» Rodbertus and Weitling also developed ideas of collectivism and premises in economics that were later incorporated in Socialist doctrine. It is only with Ferdinand Lassalle, however, that such theories were linked up with an actual working class movement. Lassalle was born at Breslau, 11 April 1825, studied first at the trade school at Leipzig and then took up philology and philosophy at Breslau and Berlin, passing his examinations with distinction. He became involved in the working class revolts of 1848 and came into slight contact with Marx and Engels, although there is little evidence that he was greatly influenced by them. It was not until 1862 that he delivered his famous lecture on «The Labor Program,» before an artisans' association in Berlin. The published copies of this lecture were seized by the police and Lassalle was arrested. At his trial he delivered a speech which was destined to become, under the title «Science and the Workingman,» one of the classics of early Socialism. In response to an invitation to address the Leipzig Workingmen's Association he sent his «Open Reply Letter,» in which he further explained his program and philosophy. He set forth his adherence to the Ricardian theory of the iron law of wages, which was later to become a bone of contention in Socialist circles. He urged the formation of productive associations of workingmen for which he held the state should provide the capital. To secure this end he declared that «the working classes must constitute themselves into an independent political party and must make universal, equal and direct suffrage their watchword. The representation of the working classes in the legislative bodies of Germany — that alone can satisfy their legitimate interests in a political sense.» On 19 May 1863 the Congress of Workingmen at Frankfort-on-Main adopted Lassalle's program and four days later the «Universal German Workingmen's Association,» which was later to develop into the German Social Democracy, was founded. Lassalle, however, was destined to see small fruits from his work. After a few months of tireless, energetic, eloquent agitation, with apparently small results, he was drawn into a duel on a purely personal matter, was fatally wounded and died 31 Aug. 1864. For a time considerable confusion existed. The International Workingmen's Association, whose organization at London in 1864 has already been described, began to have an influence in Germany. Wilhelm Liebknecht was its principal worker. Many of the principles of the Marxian economics which had been accepted by the International, were opposed to the doctrines of Lassalle. This was particularly true of the state-assisted productive associations. In 1867 universal suffrage was granted for the North German Reichstag and the Socialists polled between 30,000 and 40,000 votes, electing six members, among whom was August Bebel, who never ceased to play a prominent part in German Socialism, and who had been converted by Liebknecht to the Marxian position and the support of the International. In 1869 at Eisenach the Marxian wing organized the «Sozial Demokratische Arbeiter Partei.» For the next few years the strife between the Eisenachers and the Lassalleans was violent. This, however, did not prevent the rapid growth of Socialism and in 1874 331,670 votes were cast for the Socialist candidates. Three Lassalleans and seven Eisenachers, including Bebel and Liebnecht, both of whom were in prison for alleged treasonable utterances during the Franco-Prussian War, were elected to the Reichstag. This great success brought down the wrath of the governing powers and a period of persecution began, the first effect of which was to close up the breach between the two Socialist parties at the Congress of Gotha in May 1875. This union was followed by a rapid increase in the Socialist vote, which by 1877 had reached nearly 500,000. Meanwhile Bismarck was bending every energy to force repressive measures through the Reichstag. It is probable that he would have failed in this had it not been that two insane persons attempted to assassinate the emperor. Bismarck at once declared that these attacks were inspired by the Socialists, although there was never the slightest evidence to justify this assertion. However, he at once dissolved the Reichstag and by means of the most inflammatory appeals to public prejudice succeeded in getting a majority subservient to his purposes. A law was forced through which practically outlawed the entire Socialist movement. It prohibited the formation or existence of organizations which sought by Social Democratic, socialistic or anarchistic movements to subvert the present state and social order. Provision was also made that where even these very stringent measures were ineffective, any city could be declared in a «minor state of siege» in which all public activity was directly controlled by the police. The Socialists at once determined upon a policy of «shamming dead.» The organ of the Socialist party was transferred to Switzerland and from there circulated in great numbers throughout Germany. The only attempt at public propaganda within Germany was through the speeches of the Socialist members in the Reichstag. At the first election taking place under this Reign of Terror in 1881, it appeared as if the policy of suppression was succeeding, as the Socialist vote fell to a little over 300,000. From that time on, however, and in spite of oppression, the party grew by leaps and bounds until in 1890 it polled 1,427,298 votes. It being manifestly impossible to continue to consider a million and a half of voters as outlaws, the Anti-Socialist Law was allowed to lapse in March 1890 and Bismarck was dismissed as Minister. From that time to the present the Socialist movement has continued to grow.

The method of repression having failed to destroy the Socialist movement the new emperor extended the policy inaugurated by Bismarck when his «laws of exception» had shown their ineffectiveness and created the extensive system of social legislation for which Germany has become famous. In the application of this legislation the Socialists and the closely affiliated unions have played a great part.

With the growth of the Social Democratic party to a position of power with a vast number of official positions, both governmental and within its own organization, diverse tendencies developed. The officials have tended to form a «right» wing and with them went a considerable section of the newer voters, especially in South Germany. This section tended to relax much of the old revolutionary position of the party and was largely responsible for the divisions which took place in regard to the voting of military credits in the period immediately preceding the war. Throughout the war the minority wing under Haase and Ledebour preached international Socialism as of old but the majority under Scheidemann identified themselves more or less with the Imperialists and held out for a peace honorable to Germany. The minority desired an immediate peace; condemned war in general and named capitalism in all nations as the real enemy. The collapse of the empire in the fall of 1918 proved to be the long-awaited opportunity of the Socialists. Ebert and Scheidemann became the leaders of the new Socialist republic of Germany. See WAR, EUROPEAN.

THIRTY YEARS' GROWTH OF THE SOCIAL DEMOCRATIC PARTY.

YEAR	Popular vote	Members
1871	124,655	2
1874	351,952	9
1877	493,288	12
1878	437,158	9
1881	311,961	12
1884	549,990	24
1887	763,128	11
1890	1,427,298	35
1893	1,786,738	44
1898	2,107,076	56
1903	3,010,771	81
1907	3,259,020	43
1912	4,250,329	110

France.— France was the home of the Utopian Socialism. St. Simon, Fourier, Cabet and Louis Blanc were among the early founders of this phase of Socialist thought. As early as 1848 the word Socialism had become familiar in French politics. The Commune, 1871, was largely directed by Socialists. When it fell many of these were exiled or imprisoned. When Socialism became again a recognized political movement it was split into several factions. These later united into a single party with numerous individuals, who had formerly been Socialists, outside of any party. Some of these have since risen to great prominence in the French government. Such are Aristide Briand, several times Premier, Viviani and Millerand. Jean Jaures, by far the best known of French Socialists, was assassinated at the outbreak of the European War. He had been the Parliamentary leader of the party for several years. Jules Guesde, one of the founders of the movement and the foremost French representative of Marxism, entered the War Cabinet, as did also Albert Thomas who became Minister of Muntions and organized the work of manufacturing supplies for the army. Socialist thought has long had an influence in France far beyond its ever large vote. There have been few cabinets for several years without at least one ex-Socialist included and nearly all these have claimed that their Socialist views are unchanged but have offered some excuse for separation from the organized movement. The electoral strength since the first election is as follows:

	Vote	Deputies
1893	440,000	32
1898	751,554	38
1900	863,159	44
1906	878,000	54
1910	1,110,000	76
1914	1,400,000	102

After the invasion of Belgium in 1914 the French Socialists supported their government under the leadership of Jules Guesde. During the progress of the war a small but powerful group developed in opposition to the majority. By the time of the Socialist Congress at Bordeaux in October 1917 this group had impressed its views on a majority of the party and carried through a majority resolution endorsing the Stockholm Conference, declaring for national defense and for participation of Socialists in the government under certain conditions. A minority resolution declared its disapproval of voting credits to the government in any but a war of defense and in favor of a peace without annexations and without indemnities. France sent three delegates to the Inter-Allied Socialist and Labor Conference of 1918 at which documents were published representing the most constructive note so far struck by the Socialist or labor movements. One of these dealt with the war aims of the Entente, while the other proposed a program for social reconstruction which was afterward presented to the Peace Conference at Paris.

Austria.— The diverse nationalities that made up the former Austro-Hungarian Empire made the work of organizing a united Socialist movement difficult. A branch of the «International» existed in Austria in 1867. In 1869 it organized a demonstration in which 100,000 men marched to the palace in Vienna to demand universal and direct suffrage, freedom of speech and association and liberty of the press. Profuse promises of reform were made by the government while the workers were around the palace, but as soon as they were disbanded the leaders were arrested and a period of brutal suppression which followed momentarily annihilated the Socialist movement. The present party, which is an outgrowth of the union movement, was organized at a congress in Vienna in 1888. It began with a demand for an extension of the suffrage and succeeded in gaining a class system, in which the nobility and clergy form one class, the great capitalists the second, small property-owners the third and the wage-workers a fourth, each with equal representation. Even under this system the Socialists succeeded in casting 750,000 votes in the fourth class and electing 10 members of the Reichsrath. In January 1907 as a result of a threatened general strike the suffrage in Austria was made universal and direct. In the elections held in May of the same year the Socialists cast 1,041,948 votes and elected 87 representatives. Then came a period of reform parliamentarism which discouraged the workers so that in 1911 although the popular vote was slightly increased the number of representatives fell to 82. The party was badly split up with nationalist quarrels and a small faction also split off in opposition to the war.

During the first three years of the war the Austrian Socialists were rendered impotent through the strong militarist policy of the imperial government. By 1918, however, Socialist demonstrations increased; a "peace strike" involving 100,000 in Vienna alone was inaugurated in January. The Socialists protested vigorously against the emperor's instructions to the Premier on 4 May to take measures to prevent the reassembling of Parliament. The Social-Democratic party on 2 June demanded the assembling of Parliament and the initiation of steps toward peace. During the summer Bolshevik influences were manifest in several parts of the empire. Revolutionary activity increased and mutiny and desertion were rife in the army. The fall of the empire came on 3 November, a provisional government was organized and a republic proclaimed, which was composed of the moderate wing of the Socialists. In Hungary a more radical group seized the reins of government and chaos resulted for a time.

Great Britain.— The Socialist movement in Great Britain has always been distinguished from that of the Continent by a greater freedom from dogma and a greater variety of expression. There has never been one large unified party and Socialist legislation has come through the action of various bodies. The Social Democratic Federation, organized in 1879 and adopting a Marxist platform in 1883, was the first Socialist party. It has gone through many changes and finally merged in the British Socialist party, which split in 1915 on the question of the attitude to be taken toward the war. The Independent Labor party, which has never been distinctly Marxian, was organized in 1893. The Fabian Society, organized in 1884, is a body of educated writers and speakers, the most prominent of whom is Bernard Shaw, and which is distinctly anti-Marxian. The Labor party, which started as the Labor Representation Committee, with representatives of all the foregoing organizations and also of the unions, is the political expression of the Socialist movement. The total membership of the bodies united in the Labor party in 1912 was given as 1,895,498. Of these 1,858,178 were included in the union membership and 31,237 were members of the various Socialist organizations. It casts about 1,000,000 votes, and had 40 members in the Parliament which was in session during the war. The Socialists of Great Britain were sharply divided on the war. The Independent Labor party fought against the war until it came, then opposed conscription and worked constantly for peace. Large numbers of its membership were imprisoned for their agitation. The Labor party, while insisting upon its position as a peace party, generally supported the government during the war. The British Socialist party split, with H. M. Hyndman, often called the father of English Socialism, leading the pro-war faction. All sections of the Labor party fought continuously to protect working-class interests during the war and were almost uniformly successful. At the general election of December the Labor party did not increase its strength, but it was successful in several by-elections held subsequently.

Belgium.— In Belgium there is but one Socialist party, the Parti Ouvrier Belge, which was founded in 1885. For several years the franchise was very limited and the Socialists were barred from any effective political action. Accordingly the early years of the party were given up to agitation in favor of universal suffrage. This culminated in a series of great demonstrations and finally in a general strike in 1893, which resulted in the granting of universal suffrage to all males over the age of 25 years. This was much qualified, for in many elections there is a complex system of plural voting by which those possessing property or special educational qualifications have two or three votes, while the propertyless wage-workers have but one. Yet at the first election in 1894 the Socialist party polled 320,000 votes and elected 28 deputies out of 152. Owing to fusion with the Liberals at recent elections it is impossible to give the Socialist vote exactly but it is generally estimated at 500,000 for the election of 1914, when 40 Socialist deputies and four senators were elected. The principal characteristic of the Belgian Socialist movement is the peculiarly close affiliation of the three phases of the working class movement, the co-operative, trade union and political activity. Practically every trade unionist is also a Socialist and a member of some one of the co-operative organizations.

Denmark.— The Socialist movement of Denmark is closely affiliated with the unions, which include 75 per cent of the working class, including rural laborers. A powerful co-operative movement among the farmers is also connected with the Socialist movement, and has made Danish agriculture a model of organization. The movement here has shown a steady growth and in 1913 the Socialists polled more votes than any other political party, and 30 per cent of all votes cast. The king asked the Social Democrats to form a government. They refused to do this but agreed to support a radical government if pledged to a series of reforms for which the Socialists had been fighting. These reforms included universal suffrage for all men and women over 25 years of age, direct election of members of Parliament by popular vote and the removal of all right of appointment to office from the king. This agreement was made and the radicals formed a government. But upon the outbreak of the war an effort was made to postpone these measures. The strong Socialist representation refused to compromise and on 5 June 1915 the suffrage law demanded went into effect, and the other measures were taken up for consideration. The vote of the party from the beginning has been as follows:

1872	268	1898	31,872
1876	1,076	1901	42,972
1881	1,689	1903	55,479
1884	6,806	1906	76,612
1887	8,408	1909	93,079
1890	17,232	1910	98,718
1892	20,094	1913	107,365
1895	24,508		

The Socialist strength in the government was impaired at the general elections of April 1918 at which but 39 Socialists were returned members of the Folketing.

Finland.— The Finnish Socialist party was established in 1899 and in 1916 became the first Socialist party to gain an absolute majority of any legislative body, by electing 103 out of the 200 members of the Finnish Diet. Owing to the activity of the Socialists, Finland was the first European country to grant absolute political equality to women, and 24 of the Socialist members of the Diet are women. The vote has increased steadily from 100,000 in 1904 to 286,792 in 1916. The Socialists have organized a powerful co-operative movement with its social centres in each village so that to-day there are more Socialist clubhouses than churches in Finland. In 1917 Finland was declared an independent republic. Civil war broke out in 1918 between the Red (Bolshevik) Guards and the White Guards. The latter favored the Germans, who landed troops for their assistance. A Radical Socialist (Red) government was set up at Viborg in April 1918 and a White Guard government at Vasa. After a turmoil of several months a peaceful revolution was effected in December and the moderate Socialists secured control of the government.

Holland.— The Social Demokratische Arbeiderspartij of Holland was organized in 1894. A conflict with the anarchists, led by Domela Nieuwenhuis, formerly a Socialist, led to their expulsion from the old «Socialisten Bond,» which they at one time controlled. The «Bond» then merged with the regular Socialist party, and the daily paper, *Recht voor Allen*, founded by Nieuwenhuis, became a Socialist organ. The party grew steadily and in June 1913 cast 144,000 votes and secured 19 seats in Parliament. The Socialists then held the balance of power and were invited to join in the formation of a ministry but refused. Many important municipal positions are also held by Socialists. In the closing months of 1918 the Socialist leader in Parliament, Peter J. Troelsta, criticized the queen and incited to revolution. Riots and demonstrations were of frequent occurrence due to the high prices of food-stuffs and the general dissatisfaction with the pronounced German leanings of the queen and her entourage.

Italy.— During the years when the Socialist movements of most of the other nations of Europe were gaining their first foothold the Italian workers were still under the influence of the bourgeois liberalism of Mazzini or of the conspiratory anarchism of Bakounin. The present Socialist party was founded at Milan in 1892 and its organization perfected at Genoa in 1892. It received 27,000 votes in the election of 1893. This was followed by a period of oppression under Crispi, during which thousands of Socialist voters were disfranchised by a so-called revision of the electoral lists. The Crispi ministry was wrecked on the Abyssinian expedition and his successor, Rudini, somewhat relaxed the persecution. In 1900, owing to fusion with a radical party, 175,000 votes were cast for Socialist candidates. This was the beginning of an internal struggle that ended in 1912 in the expulsion of four of the reform wing who were members of the Chamber of Deputies. One of these, Bissolati, was the most noted orator of the party, and at the outbreak of the war entered the cabinet. The immediate result of the split, and an extension of the right of suffrage, was a most rapid growth of the party. At the election of 1913 the radical wing cast 960,000 votes and elected 59 deputies. The reform wing cast 200,000 and elected 21 deputies. The radical wing stood solid against participation in the war. The reform wing favored intervention and supported the war. A peculiar phase of the Italian movement is its great strength in agricultural sections where it has established powerful co-operative associations that directly operate the farms. See ITALY — *Italian Socialism.*

Norway.— The Social Democratic party was founded in 1887, secured 732 votes in 1894, when it first participated in the elections, and steadily increased that vote until it reached 196,000 in 1915, when 20 Socialists were elected to the Storthing. The party took a decided stand against any form of militarism at its congress in 1915, declaring for disarmament, neutrality and obligatory arbitration. The party has great power in many municipalities, a powerful women's and young people's movement and is closely affiliated with the unions and co-operatives.

Russia.— Because the Socialist movement, save for a very brief period, was compelled to organize and conduct its campaign in secret, and because of the autocratic character of the government it is difficult to give specific facts concerning it. Three parties are accorded representation by the International Socialist Congress — the Social Revolutionary party, the Social Democratic party and the Group of Toil. The latter is a peasant party, based upon the primitive communism which still prevails in Russian village and rural life. The Social Revolutionary party has adopted more or less terroristic methods which separate it from other Socialist movements. The Social Democratic party is the only one which is strictly comparable with the Socialist parties of other countries. The only time that there was an opportunity for a test of Socialist strength was in 1907, at the election of the first Duma. Even then there was more or less terrorism on the part of the government. But the Group of Toil at this election sent 116 members to the Duma, and the other two parties combined, 101. Election laws and the suppression of open propaganda reduced the legislative strength of all these parties to a small fraction of these numbers. It later became almost impossible for a Socialist to be elected or even to vote. Yet in spite of these laws there were 13 members of the Socialist group in the fourth Duma, which was in session when the war broke out. All of these refused to vote for the war credits and opposed the war. In revenge the government sent five social Democratic members to Siberia. The Social Democrats continued to spread their Marxian doctrines despite government repression and united other wings of the Socialists to bring about the revolution of March 1917 which put an end to Tsarism. Kerensky, a revolutionary Socialist, became Minister of Justice in the new government. The Social Democratic party issued an appeal to the workers of all countries to unite in putting an end to a war, begun and carried on solely for the benefit of kings and financiers. In June 1917 Lenine, the radical Socialist, attacked the war policy of Kerensky's government. On 7 Nov. 1917 the Bolsheviki revolted under Lenine and seized the government. The Bolshevik government at once proposed a three-month's armistice, and at once set about publishing the secret treaties made by the Tsar's government with the Allies. The internal policy of the new radical Socialist government was inaugurated by a series of decrees transfering property. Through many vicissitudes the Bolsheviki remained in power and administered the government upon the basis of extreme Socialism.

Switzerland.— Long the home of exiled revolutionists, one of the strongholds of the «International,» several of whose congresses were held in Geneva, it was not until 1888 that a Social Democrate party was founded in Switzerland. To be sure, the Grütli Verein, had existed as a political working-class organization of a democratic-radical character since 1838. In 1901 it joined with the Social Democratic party, retaining its autonomy. The vote in 1911 was 120,000. This was increased somewhat in 1914 when 18 Socialists were elected to the National Council. The extensive unemployment due to the war caused a slight falling off in membership in 1915–16. The party maintained its pacifist position throughout the war and worked constantly to secure similar action by other parties.

Spain.—At a congress held in Barcelona, June 1870, it was claimed that 40,000 members of the «International» from Spain were represented. Owing to the disruptive influence of Bakounin this movement almost completely disappeared. The present Socialist party was founded in 1879, but was not strong enough to hold a congress until 1888. In 1891 it received 5,000 votes. This vote was regularly increased until in 1910, when a coalition was made with the Liberals, 41,000 votes were polled, and Pablo Iglesias, long the most prominent member of the party, was elected to the Cortes. He was re-elected in 1912, when a further slight increase in the vote was secured.

Sweden.— The propaganda of Socialism was introduced into Sweden in 1881 by August Palm. In 1889, at the first trade union convention held in Sweden, the program of the German Social Democrats was adopted and the unions have ever since formed the backbone of the Socialist movement. The party grew steadily in membership until 1909 when, as the result of the defeat in a general strike, it fell off from 112,693 to 60,813. The growth then began again and continued until 1915 when it was about 90,000. There have been sharp divisions in the party in recent years. The more radical section wished to conduct an active campaign for a republic which the conservatives opposed. This division climaxed in a split over the attitude of the party on the war. Whether this split will continue after the war cannot now be foretold. An election in 1915 resulted in 265,000 votes for the Socialists, and the election of 87 members of Parliament. This makes the Socialist party the strongest with 86 Conservatives and 45 Liberals in opposition. A powerful young Socialist movement which works with the radical wing is one of the features of the Swedish movement.

Australia.— The Australian labor movement has been characterized as «Socialism without phrases» and, while many Socialists would dispute the characterization, it has a large element of truth. The Labor party, which has a majority in both houses of the federal Parliament and in two out of six state legislative assemblies and strong representation in all the others, does not declare for the socialization of industry. Indeed it specifically announces that it does not stand for the socialization of certain industries such as the retail trade. Yet is has gone much further toward the state ownership of industry than any other party and, during the war, went to great lengths in the nationalization of certain branches of the retail trade. The total vote of the Labor party is estimated at about 2,000,000. There is a small orthodox Socialist party in every state which keeps up a sharp criticism of the compromising character of the Labor party. The latter is a direct creation of the union movement and is controlled more by the union congresses than by any machinery of its own. During the war the party divided on the question of conscription which was endorsed by many of the leaders, including Premier Hughes, but which was defeated by a referendum. Since most of the opponents of the Labor party were conscriptionists this would indicate that a majority of the Labor party are in favor of a more radical program. This conclusion is drawn from the fact that the radical, more orthodox Socialist wing, fought conscription successfully.

China.— The Socialist movement in China, which had existed in a rather indefinite way for several years, sprung into sudden prominence when its leader, Sun Yat Sen, was elected as the first president of the short-lived republic, the Parliament of which also contained 30 Socialists. At this time the party had a powerful press, a wide spread organization and a program based upon that of international Socialism, modified to meet Chinese conditions. But the movement was manifestly exotic, dependent largely upon foreign educated students, and went down when the rebellion was crushed by Yuan Shi Kai. It is difficult to tell how much of the movement remains, but there is certainly a strong organization working for Socialism in China.

Japan.— The Japanese movement, which is directly affiliated with the international movement, has existed since 1899. The government has pursued Socialists with a brutal persecution which culminated in the hanging of 12 in 1910 and the imprisonment of a large number of others. As was natural, persecution drove Anarchists and Socialists together and led to reciprocal violence. In spite of the persecution many of the foremost scholars of Japan have identified themselves with the Socialist movement and it maintains a press of considerable importance in which Socialism is taught indirectly through discussion of current questions.

There are also strong Socialist movements in Bulgaria, Serbia, Rumania, Greece, Hungary, Poland, Portugal, Canada, Argentine, Brazil, Chile, South Africa and New Zealand. In fact it is now impossible to name a section of the world where capitalism has reached that Socialism has not followed like a shadow. There have been many compilations of the total Socialist strength. The following, prepared by the information department of the Socialist party of the United States, while not at all points agreeing with the figures given elsewhere, is probably as close an approximation to the situation in 1914 as can be obtained.

			Parliament	
COUNTRY	Membership	Vote	Socialist	Total
Argentine	4,000	48,000	10	120
Australia	200,000	678,012	66	111
Austria	289,524	1,053,627	82	516
Belgium	269,830	483,241	40	186
Bulgaria	6,000	85,489	20	211
Canada	6,180	15,857	...	...
Denmark	52,000	107,412	36	114
Finland	51,798	310,503	90	200
France	63,358	1,398,771	101	597
Germany	982,850	4,250,399	110	397
Great Britain	100,000	378,839	42	670
Greece	1,000	12,000	...	181
Hungary	100,000	....	...	...
Italy	40,000	997,000	79	508
Luxemburg	....	4,000	7	53
Netherlands	20,623	145,588	18	100
New Zealand	52,000	44,960	4	80
Norway	43,557	124,594	23	123
Portugal	3,500	3,308	1	164
Rumania	....	2,057	...	...
Russia	168,000	200,000	14	442
Serbia	3,000	25,000	2	166
South Africa	....	26,098	7	121
Spain	40,000	40,791	1	406
Sweden	70,000	229,339	73	230
Switzerland	31,384	105,000	15	189
United States	118,045	931,406	...	531
Totals	2,716,649	11,701,291	841	6,416

In addition to the vote and membership figures as given above, there are also Socialist movements in Armenia, Bolivia, Chile, China, Cuba, Iceland, Japan, Newfoundland, Persia, Turkey and Uruguay.

United States.— The industrial condition of the United States prevented the appearance of any strong Socialist movement until within comparatively recent years. The presence of an ever-moving frontier led to a social stratification by geographic stages which was constantly changing and which, therefore, prevented the appearance of any such continuous class struggle as a Socialist philosophy presupposes. The presence of free land and the expanding market meant a large opportunity for individual advancement, both from the ranks of laborers to capitalist and from small capitalist to large capitalist. The Socialist movement is peculiarly a product of the industrial proletariat, and while the population of the United States remained largely rural such a movement could gain no great strength. Again, the existence of chattel slavery throughout the South, prior to the Civil War, created an economic contest between these two forms of industrial organization which overshadowed the still somewhat indistinct contrast between laborers and capitalists. But though these industrial conditions prevented the growth of Socialism in the Eastern sections they gave the greatest encouragement to the growth of a Utopian Socialism, and so it came about that for many years the United States was the experimental ground on which were tested the various theories of European Utopians. These movements are often confounded with latter-day Socialism. They really had practically no connection save that both have the idea of collective production. But the collective production of the colony is to be a scheme worked out in our present society, while the collective production of modern Socialism is simply one phase of the coming social stage. William Weitling came to America in 1849 and succeeded in organizing something of a Socialist movement in New York in the years immediately following. His movement, however, was of short duration as was also that of Joseph Weydemeyer, who came shortly after him and who was a personal friend of Marx and Engels. The Civil War wiped out nearly all traces of both of these movements. After the War the influence of the «International» extended to America. This influence was first seen in the National Labor Union in which William H. Sylvis was the most prominent worker and which practically disappeared with his death in 1869. During the next three years numerous sections of the «International» were organized throughout the country, and on the removal of the «International» to this country some attempt was made to revive it, but its last convention was held in Philadelphia 15 July 1876, and this convention formally dissolved the organization. On 4 July 1874 the Social Democratic Workingmen's party of North America was organized with a rather indefinite Socialist platform. This grew in strength during the next few years and in 1877 the name was changed to the Socialist Labor Party of North America. Following the extensive labor troubles of 1876 and 1877 this party grew into national prominence and succeeded in electing minor officials in several States. But it was still too indefinite to protect itself from anarchistic influences which crept in and which nearly wrecked the party until finally those influences reached their climax and their end in the Haymarket incident in Chicago. The work of organization had now to be practically all done over again. In September 1887 the Sixth National Convention of the Socialist Labor party, held at Buffalo, N. Y., took up the work of reorganization. The Socialist elements in the labor movement were still rent with internal feuds, but by 1889 a steady upward growth began to be seen. Meanwhile, certain other movements which have undoubtedly contributed to the strength of Socialism had developed. The Greenback party and the Henry George movement both contained many of the ideas of Socialism and undoubtedly proved a means by which many were led to adopt the Socialist position. In 1892 the Socialists for the first time nominated a Presidential ticket consisting of Simon Wing of Boston, Mass., and Charles H. Matchett of Brooklyn, N. Y.

In 1899 the Socialist Labor party split, largely over the proper relation to be maintained between the party and the unions. The largest fraction united with the Social Democratic party that had sprung up around Eugene V. Debs as a result of the American Railway Union strike in 1894. This union took place at a convention in Indianapolis, July 1901. For four successive elections Eugene V. Debs was the Presidential candidate, polling a steadily increasing vote. The party has also elected many members of State legislatures, two members of Congress and many municipal officers. The party membership for 1915 was nearly 100,000. The vote of the two parties from their establishment has been as follows:

YEAR	Socialist Party	Socialist Labor Party	Total
1888	....	2,068	2,068
1890	....	13,704	13,704
1892	....	21,512	21,512
1894	....	30,020	30,020
1896	....	36,275	36,275
1898	....	82,204	82,204
1900	96,931	33,405	130,336
1902	223,494	53,765	277,257
1904	408,230	33,546	441,776
1906	331,043	20,265	351,308
1908	424,488	14,021	438,509
1910	607,674	34,115	641,789
1912	901,062	30,344	931,406
1914	874,691	21,827	896,518

The Socialist party throughout the war continued its "active and public opposition to the war." Numerous groups tried without success to modify this opposition. As a result serious defections resulted. Most of the Socialist periodicals were denied the second-class mailing privileges and many were arrested and imprisoned under the Espionage Act and other war-time laws. In the elections of 1918 Socialist represention was cut down in many instances through the fusion of the reactionary Republican and Democratic parties. The Socialists who opposed the anti-war activities of the old party formed a separate organization called the Social Democratic League. It supported the war on the same bases as the Inter-Allied Socialist and Labor Conference.

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SOCIALIST PARTY, The. See SOCIALISM.

SOCIETIES, Criminal. To find the origin of the idea that has given the world its criminal associations it would be necessary to conduct the search into the realm of fables, for if there has been a time when bands of outlaws have not levied tribute upon poorly protected property, history is silent upon that point. Modern brains only have comprehended the full possibilities of the co-operative idea as applied to the commission of crime, but the earliest applications of the theory, however crude, were probably quite effective. When in the 11th century, Assanben-Sabbah, the «Old Man of the Mountains,» securely protected in his rocky fortress, inspired and directed the horrible crimes of his great band of devoted, hashish-drunken followers, he taught the world a new truth and presented it with a new word, neither of which have been forgotten. The truth was the first clear demonstration of the fact that when associated crime is well organized and carefully directed, ordinary methods of protection are powerless to cope with it. The word was «assassin,» the title derived from his own name, which he bestowed upon his band. From that time the criminal association has been too serious a matter to be the inspiration of either song or story. Any attempt to tell the story of the modern criminal society begins with the Camorra and the Mafia, the two most powerful organizations of the kind the world has ever known. Born and nurtured in Italy, at the dawn of the 19th century, they grew and waxed strong until the one-time clubs of petty criminals had become the gigantic octopus which overawed the entire country and threatened to cause the downfall of the government which had so carelessly permitted such development of a lawless course. Efforts have been made, of late, to cast the shadow of uncertainty upon the primary purpose of these societies. It has been suggested that they were originally organizations of patriots who had banded together to protest against existing tyrannies. A careful study of the history of the time, however, and a close examination of the earliest works of the associations will prove the fallacy of such a theory. Instead of having a noble past to look upon, these organizations have always been bands of the most heartless criminals, a constant menace to any government and to all laws.

For some time before the Camorra's time, Italy had been writhing in agony beneath the heels of the most corrupt and incompetent body of officials who ever attempted to rule a nation. The one object of the government was to extract as much money as possible from the people and to give absolutely nothing in return. Taxes which were high were collected relentlessly, but little of the money obtained was expended for the benefit of those who had been taxed. Governmental works were at a standstill, government officials were unpaid and the immense sums of money which had been extorted from the people were wasted upon royal favorites. Little by little the corruption in high places permeated the whole fabric of society. Justice became a thing unknown. If suit was brought the richest man won, for there was not a judge in the land who was not willing to sell his decision to the highest bidder. Acting upon the same principle the police became the partners of the criminal. As personal wrong and offenses against the laws were never punished, crime became rampant. The poor, robbed by the rich, proceeded to recover from their oppressors by force that which had been taken from them by process of law, and life became a thing of little value.

Then came the French, with their peculiar form of oppressions, which culminated in the theory that a man in prison was a more tractable subject than a man at large. In pursuance of this idea thousands of arrests were made, and the men, unconvicted, were left behind the bars. In a week the poor penal accommodations of the country were taxed to the last limit, but, as the work had only just commenced, castles were seized and turned into prisons. Having arrested their men, however, the French dismissed them from mind. «We will watch them to prevent their escape,» they said, «but we will let the local authorities feed them.» But as the local authorities had too much trouble to raise the indemnities demanded by the conquerors to think of bothering themselves about men who were securely locked behind iron bars, prisoners who were not blessed with independent means had no other option than to starve. As the natural result the strong commenced to prey upon the weak and anyone who had money was robbed without mercy. Among the prisoners there was one in whose brain lodged the seed of socialism. This man was Antonio Giaperelli, and to him belongs the somewhat doubtful honor of having organized the first society of the Camorra. He had noticed that, while new prisoners were always robbed immediately upon their arrival, few of the inmates of the prison profited by these robberies, and he suggested a plan providing for the systematic fleecing of all newcomers, the plunder to be shared equally among all the prisoners. The suggestion met with the approval of the majority and the scheme worked so well that it was not long before the plan was adopted in every prison in Italy. For a time the organization of the Camorra was thus confined within prison walls, but as the members were released it was suggested that a plan that had worked so well under circumstances in which the opportunities for plunder were so meagre might advantageously be extended. Up to the year 1828 the word Camorra had no meaning except to those who had made the acquaintance of the society in some prison, but during that year the name was written in letters of blood that made all Italy tremble. One day a merchant in the city of Naples was visited by a stranger who asked him to contribute to the support of the «Camorra.» Not knowing the man, and never having heard of such an organization, he naturally refused. The visitor insisted and the merchant was finally compelled to eject him from the shop. Other stores were visited, with a like result, and the strange collector disappeared as he had come, unknown to all. The next day Naples had its sensation. When the wife of the first merchant had attempted to waken her husband she had found him dead in bed, and the stiletto that pierced his heart held to his breast a placard on which it was stated that his death was the result of his refusal to assist in the support of the Camorra. A day or two passed, just time enough to allow the story to become generally known, and then another stranger appeared upon the streets of the city. Store after store was visited and the same request was made, but this time the words, «for the Camorra» carried such frightful import that many merchants submitted to the blackmail. Some refused, however, and the next morning the murder of another business man warned the people of the uselessness of their attempt to withstand the demands of the order.

From that day the power of the Camorra became practically absolute. From city to city its work was extended until its name was heard with dread in every part of Italy. At regular intervals each storekeeper received a visit from the strange collector and, as death was the penalty of refusal, the money demanded was usually paid without protest. No one was exempt. Wherever goods were sold or trade of any kind was carried on the importunate collector stood ready to receive his share of the profits. He was permitted to go everywhere. He was at the custom house, where he collected his tolls as conscientiously as if he had been a government agent. If money was deposited he stood by the side of the depositor in the banking house. Nothing escaped him, and when the business day closed he paid his visits to the wine shops, the gaming houses and all dens of vice, for the officials of the society were not particular as to the methods used in the making of money so long as they received their share of the spoils.

In this manner was the country terrorized by the operations of a society which had become more powerful than the government. Several half-hearted attempts were made to suppress it, but as its membership was composed of persons from every walk of life the blackmail continued, and at last became open highway robbery. Then it was that the streets of the cities became unsafe either by day or night, and the finding of a dead body on the public highway was of such frequent occurrence as to occasion but little comment. The victim had simply refused to pay his tribute to the Camorra.

It was not until 1877, therefore, that any progress was made in the restoration of order. Then United Italy took the matter in hand, and as this crusade was conducted by honest men who were ready to act with energy and determination, hundreds of the agents of the association were soon arrested, and, as executions and long imprisonments followed, penalties to which the highest as well as the lowest were subjected, it was not long before the dreaded Camorra ceased to be dreaded.

While never as powerful an influence for evil as the Camorra, the Mafia was organized upon similar lines, and the fact that it is more recent makes it of greater interest. Like the parent society its purpose was one of murder, robbery and blackmail. Like the parent society it became stronger than the government in its own country, and, as in the case of the Camorra, was only subdued by the exertion of the authorities of the United Italy.

There were two factors that played an important part in the organization of the Mafia. The first was the presence of numerous bands of outlaws organized as a protest against the non-resident land ownership, which had caused so much poverty and misery in that part of the country. There can be no doubt but that these conditions were about as hopeless as present-day imagination can picture. The Sicilian peasants had suffered untold miseries at the hands of the heartless agents of the alien landlord, and the ignorance and natural viciousness of the people could suggest but one way out of the difficulty. Assassination and robbery was the remedy. The other factor was the presence of thousands of bravos, soldiers and courtiers who had lost their occupation when Ferdinand granted the demand for a liberal form of government. The abolition of the petty courts, of which there had been so many in the Two Sicilies, threw these men out of employment, and, as they cared neither to work nor starve, they naturally thought of brigandage as the one way out of the difficulty. With that idea in view scores of military clubs were formed and these were the cloaks behind which the members committed their murders and robberies. It was at this time that Mazzini appeared upon the scene. How much he saw of the patriotic side of the question, how much of the criminal, will never be known. We only know that it was his constructive genius that welded the two factors together and that it was to him that we owe the existence of the Mafia. Strange as it may seem the name «Mafia» is meaningless and the word does not appear in any dictionary of the Italian language. In fact, up to the year 1859 the word itself had not been coined. It was only when Mazzini had gone from club to club, and from outlaw band to outlaw band, forming branches of his secret society that such a title was conceived. Mazzini called his united clubs «Oblonica,» a name which was derived from two Latin words, «obelus,» a spit, and «nico,» I beckon, meaning «I beckon with a spit,» the latter, of course, being the stiletto with which the society was to do such deadly deeds. To say that Mazzini was thoroughly in sympathy with the horrible work to which the society later devoted itself is to go a step beyond the historical, but its purposes, as expressed in the words, «Mazzini autorizza furti incindi avvelenamanti,» meaning, «Mazzini authorizes thefts, arson, poisonings,» gave to the association of criminals its name, the initial letters of the five words being used to form the new word, «Mafia.»

The extent to which the Mafia had expanded was shown in 1876, when the government was called upon to investigate the abduction of an Englishman named Rose. The sum of $20,000 was demanded, and paid, for his release, and the investigation which followed was so revolting in its details that the result was suppressed by the authorities. It had been shown that the money had been divided among many people of various conditions, from the peasantry to the commander of the post, whose gendarmes were supposed to be pursuing the bandits; the chief of police and detectives of the district, and even the judges of the courts, they having promised immunity in case the abductors should be captured. When the government of Italy was notified of these facts it took the matter in hand. The corrupt soldiers and officials were sent to another part of the country, being replaced by sturdy and honest regiments from the borders of the Tyrol and the mountains of Switzerland. The new men had no sympathy with crime, no friendship for the criminal. They knew that it was their sole duty to carry out the orders of their superior officers and they performed this duty with a vigor with which even the powerful Mafia could not cope. Whenever or wherever a man was found who could not give a perfectly clear account of himself, or prove that he had no connection with the murderous society, he was shot on the spot. It has been estimated that no less than 5,000 persons met their death at this time, and while the search must have resulted in the killing of many innocent people, the object of the crusade was accomplished, and the Mafia, after its years of prosperity, was driven into obscurity. During this campaign of extermination, however, hundreds of the members of the Mafia made their escape, and many of them came to this country. Rumors to this effect were common at times, but they were not treated seriously until 1890, when the hand of the society was felt in the killing of Chief of Police David C. Hennessev, of New Orleans.

For several years there had existed two rival stevedoring firms in New Orleans, the Provenzanos and the Matrangos, which were in competition for the business of discharging and loading the vessels engaged in the Central American trade. The Provenzanos controlled this business for some time, but their services proving unsatisfactory for some reason, the work was transferred to the rival firm. Then the trouble began. The Provenzanos contended that their services had been dispensed with because the shipowners were held in terror by the Matrangos, who had threatened them with the Mafia. The Matrangos, however, denied the imputation, and made counter charges in which the Mafia played an important part. In accordance with his duty the chief of police proceeded to look into the matter. Absolutely honest and utterly fearless David Hennessey realized that his discoveries would cost him his life if the society he had unearthed should ever be able to reach him. "They may get me," he said to a friend, "but if they do they will get me in the back," a prophecy which was realized on the night of 16 Oct. 1890, when he was shot to death on Girod street. The assassins had been concealed in doorways and, after he had passed, had stepped out from their hiding place to rain upon him a perfect fusillade of bullets. He had threatened to exterminate the Mafia and the Mafia had replied by removing him.

The finale to the story is a unique page in American history. Arrests were made, but conviction seemed impossible, and, at last, the people of the city determined to take the matter into their own hands. That there were stiletto societies in New Orleans was no longer a matter of doubt. They existed and they threatened the security of the city. Their members had killed the chief of police and they had threatened to kill others, including Mayor Shakespeare, who had been bold enough to say:

> "We owe it to ourselves to see that this blow is the last. We must teach these people a lesson that they will not forget for all time. No community can exist with murder societies in its midst. The societies or the community itself must perish."

The blow that followed was one from which the Mafia in this country never recovered. It was not used to that treatment, and, since the New Orleans lynchings, it has not raised its head. Police reports have indicated, however, that it still exists in private, and there are occasional crimes that may be traced to its door, but this dark-cellar existence has little about it to inspire dread, even in the heart of the most timid. Another Italian criminal society appeared in Turin in 1868. Organized for the systematic commission of large criminal affairs, it made a specialty of safe-robbing, but undertook any promising robbery, and did not hesitate at murder. At one time they had 200 members. When the public became aroused to extirpate them, few could be located, and it was believed that most of them escaped to the United States. From 1905 to 1909 "Black Hand" associations were active in the United States and led to the assassination in Palermo 13 March 1909 of Joseph Petrosino, a New York detective who had shown especial skill in tracking the criminals.

From time to time organizations, more or less criminal in purpose, have come into existence in the United States, and it argues well for the character of the people that their life has invariably been of brief duration. As long as the Ku-klux Klan maintained its original purpose it was unmolested, but when its members resorted to the deeds of violence and bloodshed which made its name the synonym for the most brutal lawlessness, both North and South joined hands to wipe out the organization. See KU-KLUX KLAN.

With 12 murders and a countless number of attempted assassinations to its credit Mollie Maguireism terrorized the coal fields of Pennsylvania for more than 20 years. Unlike the Ku-klux Klan, the Molly Maguires were utterly devoid of noble principle. The first lodge was instituted with criminal purpose and from that day until the last Molly murderer was hanged it remained the most thoroughly organized murder society this country has ever known. For years it was the power which ruled in the coal fields. See MOLLY MAGUIRES.

From the time of its earliest historical record Asia has been at the mercy of its murder societies and other criminal organizations. The dacoits of India, the Hindu thuggee, the khunhuz of northern Asia, all prove that, from one end of the continent to the other, criminals believe in seeking safety in numbers. The Boxers of China, who are but one of the many criminal wings to the vast secret society system which prevails in that country, have exploited their strength so recently that their horrible work is still fresh in the minds of the civilized races of the world. For absolute corruption, for unalloyed crime, no criminal organization yet known to history can compare to those of China, and some of these associations still flourish, to a certain extent, in every large city in this country under the name of highbinders. One of the most powerful is the Sam Hop, known here as the Chee Kung Tong. The history of the Sam Hop Tong can be traced back more than 250 years. According to tradition it has existed since the establishment of the Chinese nation. Its organization is said to have been due to divine revelation, and it is known that, in its early days, its character was enirely patriotic. It has always been a power in the Celestial world. It helped to overthrow the Tartar Dynasty, it was the cause of the Tai-ping rebellion, and of the more recent Ko Lo revolution. Many of the most frightful outrages against the missionaries can also be traced to the Sam Hops. During the two or three centuries of its existence, however, the character of the association has changed. From a patriotic organization, whose only object was to protest against the outrages of a foreign dynasty, the society has become an association of men banded together solely for purposes of murder, robbery and blackmail. On arriving in this country the Sam Hops organized under the name of Chinese Masons, and it was not until 1891 that the police accidentally discovered that the apparently innocent title was a shield to disguise a criminal association. By this time, however, the Chinese quarter of San Francisco had become a hot-bed of crime and highbinder outrages were of frequent occurrence in every large city in the country. Victims of the Sam Hops, unwilling to apply for police protection, organized rival tongs. At first the murders had been committed only by ones or twos, but finally pitched battles were held on the streets, on which occasions scores of lives were taken. These murders, however, were not the only bad feature of highbinder domination. When the members were not killing each other they were levying blackmail upon merchants and wealthy Chinese, compelling them to pay exorbitant prices for the privilege of being unmolested. They also pursued highway robbery with perfect fearlessness and assumed entire control of the traffic in slave girls. In San Francisco, where they were most bold, the police often declared war against them, but with little success until about 1898, when the Chinese business men took the matter in hand, and, at their request, the Chinese officials in this country appealed to the home government for assistance. Then a crusade in earnest was undertaken. The meeting places of the various tongs were found and broken open; record books and other documentary evidence was seized, and hundreds of arrests were made. As the punishment which followed these arrests was applied in the Chinese custom, extending to the relatives of the offenders, those who were still in China being killed and tortured, it was not long before the criminal organizations were driven into comparative obscurity.

The most noxious criminal organizations in the United States have existed in the larger cities, where they have resorted to a higher class of frauds and robberies. Those that have devoted themselves to the open country, on the other hand, have been made up of men of a lower criminal stamp, like our own gangs of outlaws, and have been guilty of murder and robbery with violence. Usually these bands have been composed of young men, under the leadership of the most determined man in the company, as in the case of the Younger and James gangs, but there have been instances in which even women have been the leaders of such associations of lawbreakers. Louise Bouviers headed a society of 40 men, and the leader of one of the most heartless companies of Indian dacoits was a woman. While such bands of criminals have usually been recruited from the lower walks of life, instances are not wanting in which men of education and social position have resorted to this method of gaining a livelihood. One society of thieves which terrorized Mayence, in Germany, for several years, was led by an ex-priest, while the «Habits Noirs,» or evening-dress gang, of Paris, was composed of persons of excellent social standing, who had met with financial reverses. In 1837 the authorities of Rome discovered and broke up an organized criminal society, many of the members of which were connected with the noble families of Italy. Among those arrested were Count Dionisi de Traja and the Countess Angellucci de Traja, as well as several members of the Pope's bodyguard, all of whom had been long esteemed as persons of an exemplary character. France has often been at the mercy of such criminal societies, and there is reason to believe that crime clubs exist at the present time.

In 1849 the Thiberts were disbanded, after they had been successful in pursuing all kinds of criminal operations. This association, which numbered more than 800 members, was composed of every variety of criminal, all working, in perfect harmony, under one director. What one branch could not do, another accomplished, and there was no phase of crime which could not be undertaken. The disbandment of the Thiberts, however, was the signal for the organization of other associations along similar lines, and many of these societies were made up of seemingly harmless folk, men and women who lived in apparent respectability, or members of the same family who pursued their careers of crime under the direction of one of their number. Such a man was Hippolyte Villet, the leader of the Lamaire band, whose crimes remained unchecked from 1852 to 1855, when the criminals were exposed, and compelled to pay the penalty of their murders and robberies on the gallows.

An instance of organized criminal effort was exposed by the police in Paris in 1888. This association, known as the Catusse-Menegant, was one of the greatest of modern bands of criminals, for, while it was under the direction of two men, located in Paris, its lines extended into every part of Europe. Everywhere it had its agents, bands of pickpockets, horse stealers, housebreakers, confidence men and swindlers of every character. In addition to this it operated a banking house in London, through which it was a simple matter to negotiate its stolen stocks and bonds, or to dispose of its silver and gold. With such facilities the operations of the society were naturally enormous, and were only exposed at last through the clever work of the French detectives, assisted by officers from Scotland Yard. The real leader of the Catusse-Menegant was a man named Chambon, who, under the name of Victor Chevalier, lived with his wife in the Rue Poteau. To all appearances his sole business was that of conducting a livery stable. His arrest, and that of his lieutenants, was soon followed by confessions which enabled the police to arrest many other members of the association. They were found in all parts of Europe, and in almost every grade of society, but the evidence against them was so complete that nearly all were convicted and sentenced to more or less lengthy terms of imprisonment.

The «System,» in New York, may be looked upon as the last modern criminal association in America. It was an alliance between certain gangs and gang leaders, with corrupt politicians and corrupt members of the police force. It met its death through the efforts of Charles S. Whitman, then district attorney of New York, who convicted Lieutenant Becker, a high police official, with the murder of a gambler who disobeyed orders. Becker and his agents were electrocuted, Whitman was rewarded by being made governor of New York State, and the system received its death blow.

SOCIETIES FOR ETHICAL CULTURE. See Ethical Movement and Ethical Societies in America and Abroad.

SOCIETY OF AMERICAN ARTISTS, an association of painters and sculptors in New York City, founded in 1877. Its membership included the leading artists in the country, and during 29 years the society was a considerable factor in the advance of art ideals in the nation. Nearly all its members being identified with the National Academy of Design, it was considered wise to merge interests and prizes with that organization in 1906, when it became affiliated with Columbia University and the Metropolitan Museum of Arts. See National Academy of Design.

SOCIETY OF THE ATONEMENT. See Orders, Religious.

SOCIETY OF CAMORRA. See Societies, Criminal.

SOCIETY OF THE DIVINE SAVIOUR. See Orders, Religious.

SOCIETY OF THE DIVINE WORD. See Orders, Religious.

SOCIETY FOR ELECTRICAL DEVELOPMENT, an association organized in 1912 to carry out in a broad way co-operative electrical development between the various branches of the industry and the larger electrical companies. The headquarters are at 29 W. 39th street, New York, and the membership is 1,300.

SOCIETY OF THE EPIPHANY. See Orders, Religious.

SOCIETY OF THE FAITHFUL COMPANIONS OF JESUS. See Orders, Religious.

SOCIETY ISLANDS (Tahiti), South Pacific Ocean, a French dependency, between the Low Islands and the Friendly Islands. This is the largest group of the Leeward Islands, and consists of the principal island of Tahiti (q.v.) or Otaheite, which is about 32 miles long northwest to southeast, and is divided into two peninsulas by an isthmus about three miles broad; and a great number of comparatively small islands, of which the most deserving of notice are Eimeo or Moörea, Maitea, Tetuaroa, Maiaoiti or Saunders Island, Tahaa or Otaha, Marua or Maupiti, Tubai or Motu-Iti, Huaheine, Raiatea or Ulietea- and Bora-Bora. The islands are of rugged surface and conical form, encircled by coral reefs. Sharp peaks usually rise midway in the islands from a low band lining the shores and blooming with groves and orchards. The wooded mountainous slopes are intersected with valleys watered by rapid streams often falling in steep cascades over the rocks. The locality is of great geologic interest, the volcanic rocks being exceptional. Coral beds are found high up on the mountain sides and many curious lava formations. The highest point is on Tahiti, 7,349 feet. The scenery is idyllic, especially in Eimeo. The coasts contain safe and commodious harbors, the best in Polynesia. The climate, though extremely hot and damp, is healthful. Cotton and sugar, sweet potatoes, bread-fruit and taro are grown, and all kinds of tropical fruits — cocoanuts, vanilla and oranges. The exports include these, together with trepang, cocoanut fibre and mother-of-pearl. The imports are flour, wine, sugar, coffee, soap, timber and livestock, besides manufactured goods. Prior to their contact with Europeans, the people were naïve and ingenuous; thus Captain Cook found them and interested English missionaries in their welfare, who were successful in Christianizing them. The islands were discovered by a Spanish navigator in 1606 and were visited by English and French travelers and scientists, and finally ceded their independence to the French, becoming a colony in 1880. The capital and harbor of the group is Peete, on the island of Tahiti. Its chief buildings are a Roman Catholic cathedral, some schools and an arsenal. The people are of Polynesian extraction and famous as presenting a perfect type of face and form. In 1904 a violent storm brought disaster to the group, depopulating some islands and causing much suffering and destitution. Area, 600 square miles. Pop. about 18,000.

SOCIETY OF JESUS. See Jesuits.

SOCIETY OF THE MAFIA. See Societies, Criminal.

SOCIETY OF MARY OF PARIS. See Orders, Religious.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS, an organization founded in 1893 to promote practical and scientific knowledge in the art of shipbuilding and marine engineering and the allied professions. In furtherance of this object, annual meetings are held for the reading and discussion of appropriate papers and for the interchange of professional ideas, thus making it possible to combine the results of experience and research on the part of shipbuilders, marine engineers, naval officers, yachtsmen and those skilled in producing the material from which ships are built and equipped. The knowledge thus obtained is circulated by means of the annual publication of the 'Transactions of the Society.'

The society consists of members, associates, juniors, honorary members and honorary associates. The members' class consists exclusively of naval architects, marine and mechanical engineers, including professors of naval architecture or mechanical engineering in colleges of established reputation, who are not under 25 years of age, and who have been engaged in professional practice in a responsible capacity for at least three years. The society has a total membership of 1,000. The head office is at 29 W. 39th street, New York.

SOCIETY FOR PROMOTION OF USEFUL GIVING. This was founded in New York City in 1912, and has a membership of about 10,000. Its headquarters are at 38 W. 39th street; Mrs. August Belmont is president and Miss W. K. Oliver secretary.

SOCIETY FOR PSYCHICAL RESEARCH. See Psychical Research.

SOCIETY OF SAINT JOHN THE EVANGELIST. See Orders, Religious.

SOCIETY OF SAINT VINCENT DE PAUL, a Roman Catholic charitable organization, founded in May 1833, in Paris, by Frederick Ozanam (q.v.) and seven companions. At their first meeting the object of the society was outlined and expressed in the few words: «Our work shall be for the service of God in the persons of the poor, whom we are to visit at their own dwellings and assist by every means in our power.» Frederick Ozanam is considered the founder, as he was the first one who suggested the work. The Saint Simonians had taunted the young men who were advocates of Roman Catholic doctrines with being talkers only and not workers. At the very next meeting of Ozanam and his friends, Ozanam suggested an organization which should occupy itself «not with discussions but with good works.»

From a membership of eight in a small room in Paris, in 1833, the society has grown to a membership of thousands with local organizations in nearly all parts of the world. The first United States society was formed at Saint Louis in 1845; the New York organization dates from 1846. The members are men from all stations in life. There are numerous auxiliary societies, composed of women, who assist in the regular work of the Saint Vincent de Paul societies. The instructions given by the Père Bailly at the first meeting created a spirit which is characteristic of the work of the present. He urged the men not to let their work be a «mere doling out of alms,» giving only a pittance of money or food, but a medium of moral improvement through personal service. Their education, intelligence, special knowledge of science and their general knowledge of life are placed at the service of those needing assistance.

The total number of Saint Vincent de Paul conferences throughout the world is over 6,000; active members over 100,000; honorary members, over 100,000. There are now branches in every civilized country on the globe. There are in the United States a general council, and special councils in every archdiocese, besides 800 conferences and over 15,000 members.

Some of the good works in which the members are engaged are visiting the sick and those in trouble; furnishing food and clothing to the needy, procuring employment for those not engaged in regular work, providing summer country homes for poor city children and homes for the homeless. The members visit the jails, prisons, almshouses and the poor of the parish. Boys' clubs have been established in many cities, and vigorous efforts are made to distribute good literature. Besides the local meetings, State and national meetings are held annually, with delegates from conferences in all parts of the United States, Canada and other countries. All the councils of the world report annually to the council-general, who has his headquarters in Paris, France. Consult 'Manual' of the society.

SOCIETY OF TAMMANY, or COLUMBIAN ORDER. See Tammany Society.

SOCINIANS, sō-sĭn'ĭ-ạnz. See Religious Sects.

SOCINUS, sō-sī'nŭs, **Faustus,** Italian theologian; nephew of Lælius Socinus: b. Siena, 1539; d. Poland, 1604. Having lost his parents while still young his education was neglected. He was obliged to leave Siena from suspicions of his entertaining heretical notions in his 20th year, and retired to Lyons. On the death of his uncle he came into possession of the manuscripts of the latter, by the study of which he found his former opinions confirmed. He began to publish his views at Florence (where he lived 12 years at the court of the grand duke, Francesco de' Medici) in anonymous writings; and he afterward retired to Basel to avoid the persecutions of the Italian inquisition. His opinions were still more fully developed during a residence in Transylvania, and in Poland he had numerous adherents. The Anti-Trinitarian societies, although they agreed with him in some points of doctrine, yet differed so far in others that they would not receive him into their communion. He formed, however, some small socities of followers there, but suffered persecution in that country, and the confiscation of his property in Italy. His death was hastened by the brutal treatment of a fanatical Cracovian mob. Those who followed the teachings of Lælius and Faustus were termed Socinians, and their theories persisted, finally culminating in modern Unitarianism.

SOCINUS, Lælius, Italian theologian: b. Siena, 1525; d. Zurich, 1562. He was destined for the legal profession, in which his father, Mariano, and several others of his ancestors, had gained distinction; but, moved by the religious discussions which then agitated the greater part of Europe, he abandoned the science of jurisprudence for the study of the Scriptures. In order to prosecute his study thoroughly he mastered the Greek, Hebrew and Arabic languages. In 1546 he was admitted a member of a secret society at Vicenza, which had been formed for the discussion of religious questions. They soon arrived at the conclusion that the doctrine of the Trinity was untenable, and that many of the dogmas of the Catholic Church were repugnant to reason, which they held to be the only court of appeal in matters of religion. The nature of their deliberations having become known the society was broken up, several of its members were arrested and put to death, and others, among whom was Socinus, left the country.

He visited France, England and Holland, and resided for some time in Switzerland, Germany and Poland, where he found many persons who were in sympathy with his views. He is the author of 'Dialogus inter Calvinum et Vaticanum,' 'De Sacramentis,' 'De Resurrectione Corporum,' and several unfinished works, which he bequeathed to his nephew, Faustus.

SOCIOLOGY. The following exposition does not attempt to mediate between the numerous claimants to the name «Sociology.» It frankly applies the name to the attempts to establish a division of knowledge co-ordinate in dignity with the older social sciences. It indicates the actual growth and present character of sociology, especially in recent years in the United States, as the subject is understood by such a representative body as The American Sociological Society. (Consult Proceedings, Vols. I–XIII).

Definition.— Sociology is primarily one of the many techniques which make up the equipment of social science as a whole. In the second place, each of these techniques is a growing body of knowledge arranged and interpreted according to the respective special standards, and each in turn is a more or less explicit body of conclusions about the bearing of the respective findings upon contemporary problems both of interpretation and of control. Chief among the other techniques for scientific dealing with social relations are psychology, anthropology, ethnology, comparative philology, history, political economy, political science and statistics. The task of social science in general, or the co-operation of these techniques, is to make human phenomena intelligible, and eventually as far as possible controllable. This task involves determination of the norm or norms according to which control should be exercised. *The sociological technique is that variant among the social science techniques which proceeds from the perception that, after allowing for their purely physical relations, all human phenomena are functions not only of persons, but of persons whose personality on the one hand expresses itself in part through the formation of groups, and on the other hand is in part produced through the influence of groups. In brief, sociology is that technique which approaches knowledge of human experience as a whole through investigation of group-aspects of the phenomena.*

In order to understand the place of sociology in the whole apparatus of knowledge, it is necessary to become familiar with the fact that the growth of the «social sciences» since 1800 has been essentially the evolution of a single scientific method, a method which, while becoming more specialized and diversified on the one hand, is becoming both more unified and more comprehensive on the other. At the same time it is assembling a more and more coherent body of knowledge and interpretation. The outcome has been not that the different divisions of social science are more isolated from one another than in 1800, but that the best work in each is certain to show effects of contact with all. This is not the traditional view. Until recently the almost universal opinion among social scientists was that the 19th century was an era of the development of many independent sciences of human life. It is not an excursus from our subject, therefore, but a necessary introduction to the most mature views of the subject, to dwell at some length upon our radical proposition.

History.—The problem of knowledge in the field of social science reduces to this: *What is the meaning of human experience, and to what extent have we developed a technique which may be relied upon to ascertain more of that meaning?* To explain the origins of sociology, we must answer the question, What has social science in general done toward working out a reliable method of interpreting human experience? (Consult Small, 'The Meaning of Social Science'). If this question were answered in full it would include an account of the evolution of philosophy and psychology since Locke in England, since Descartes in France, since Wolff in Germany. We may merely summarize to the effect that modern philosophy and psychology have found common ground with all positive science in the commonplace that all convincing interpretation of experience must be generalization of experiences. To this commonplace we may add the proposition which is not equally trite, which experience is nevertheless steadily enforcing, viz., that valid social science cannot be many; it must be one.

Sociology made its appearance as an American pursuit in 1883. For several decades American sociologists consecrated far more ingenuity and passion to propaganda of the conception that sociology is, was and ever shall be an independent science, than to search into its actual origins, and to analysis of its necessary interrelations. In this the earlier sociologists exhibited their intellectual consanguinity with most of their scholastic predecessors and contemporaries. Like so many other zealots for the advancement of knowledge, they proclaimed themselves the high priests of an independent cult, to which independent cult, however, as they often declared in the same breath, all other scientific cults must one day become subordinate. Even now this earlier misconception survives among social scientists, sociologists not excepted. In order therefore to indicate the historical relations between so much of our technique as we have thus far developed and the other techniques for investigating human experience, we must present sociology as it evolved with and out of the totality of 19th century social science.

Until now the thoughts of the vast majority of men about human experience, past or present, have been mostly nebulous, mystical, irresponsible. People in general, even including those who passed as scholars, have been content to accept versions of human experience without inquiring closely into the credibility or the sufficiency of the evidence in support of the versions, or into the conclusiveness of the inferences drawn from the evidence. On or about 1800 a movement began to be manifest among European scholars which, like most movements that later prove to be momentous, probably did not at once disclose a large fraction of its significance to many of its promoters. The date 1800 is selected for symbolic convenience. It is at the centre of events which fall within a zone occupying 25 years on either side. From the present outlook the meaning of the movement is more evident than it could have been to the men whose gradual coming-to-consciousness was the making of the movement. We embrace its entire sweep, in all dimensions, from 1800 until now, in the formula: *It was a drive toward objectivity.* For the purposes of this sketch we may define the term «objectivity» as requisition that nothing shall be allowed to pass as knowledge until in every conceivable respect it literally reflects reality. Previous to 1800, except within relatively immediate ranges of experience, that which passed as social science, under whatever name, as a rule pitiably failed to satisfy this standard. Before one-third of the 19th century had passed, European scholars in each of the then conventional divisions of social science had betrayed prophetic discontent with the existing state of knowledge in their fields, and with the current methods of search for more knowledge. They had begun to make out ways and means of making knowledge within their respective fields both more ample and more accurate. In the light of our experience meanwhile, we are accredited by the facts when we say that this discontent and this resolve presently amounted to a *concerted* drive toward objectivity in social science. Historians, economists, professors of jurisprudence were not discontented with precisely the same things in their respective divisions of labor, nor with precisely the same things which were regretted in one another's fields. They did not propose identical means of removing the obstructions of which they were severally conscious. We may anticipate the most obvious conclusions which our survey will impress, however, by pointing out that, in effect if not in professed program, the detached, provincial, unco-ordinated, uncorrelated scholarship in the social science of the year 1800 has become the comparatively organic scholarship of to-day. Bv organic, in this connection, we mean reciprocally reinforcing. There were counter-marches here and there during the 19th century, toward such specialism and isolation in research as would have threatened to reverse the movement toward objectivity. These counter-marches were not simultaneous in all countries nor in all sciences; and they did not long continue their drift toward earlier sterility. On the contrary, in spite of all the caste spirit among scholars, social science in its various divisions has become more and more interpenetrating. Since 1800 there has been on the whole an accelerated process of reciprocal assimilation of ideas between all the different departments of knowledge within the range of social science, not to speak of reciprocal modifications between physical and social science.

Priority of mention, as promoters of the drive toward objectivity, belongs to the historians. While consciousness of the past as having been, and as having had some sort of meaning for the present, had been a factor time out of mind in the thinking of both learned and unlearned, that which was accepted as history previous to 1800 was often more imaginative than authentic. Soon after 1800, the work of devising means of discriminating between false and true, between adequate and inadequate evidence, and so between trustworthy and untrustworthy reconstructions of the past, was in full swing. The technique by which the historians began to discredit previous credulity soon became known as «critical» methods, or as «historical criticism.» In his account of a type of historical or quasi-historical thinking which critical history has been trying to displace, Robert Flint schedules certain conditions, physical as well as mental, without which adequate historical interpretation is impossible ('The Philosophy of History in France and Germany,' 1st ed., 1874. Introduction). The conditions named are, first, a certain actual world-unity, such as was realized by the Roman Empire; second, a certain consciousness of spiritual unity, such as was introduced by Christianity; third, the idea of progress; fourth, the idea of freedom. It is somewhat more obvious, on the one hand that modern sociology is inconceivable in the absence of certain additional ideas to which the early 19th century historians gave currency, and on the other hand that the failure of these historians to make the most intensive use of these ideas operated as a challenge to certain thinkers to develop the suggestions until they became tools of the technique called sociology. Thus the conception of *continuity* in human institutions (Savigny, Roman law in the Middle Ages); the conception of the *multiplicity of factors* operating in historical combination and sequence (Eichhorn, German civic and legal history); the *necessity of subjecting alleged historical evidence to the severest scrutiny* (Niebuhr, early Roman history); the value of *documentation* as a basis for historical opinion (Ranke, ecclesiastical and political archives, principally of the Reformation and post-Reformation periods). Whether the sociologists have made more or less use, better or worse use of these ideas than the historians did is aside from the present point. The sociologists took over from the historians these ideas and others of more particular types, and employed them in distinctive ways. As the historians developed critical methods to higher and higher degrees of precision, sociologists became aware that the same methods, or equally penetrating methods, must be used for them by historians, or by themselves, whenever the tasks which the sociologists undertook required historical research.

Turning to another antecedent of sociology, if we trace political economy no farther back than the Physiocrats in France, or Adam Smith in England, it antedates these beginnings of critical history. In effect, however, political economy did not become an appreciable driving force in the thrust toward objectivity until the historians were well in the lead. At this point we are considering the development of political economy solely with reference to the question, What relation did political economy have to the differentiation of sociology? The substantial fact in reply to that question is that the economists were the first type of scholars to undertake the task of carrying through a completely objective analysis of what takes place in a selected human group, and of finding out why it takes place. They did not do this in a completely objective way from the beginning. They tried to, nevertheless. In making the attempt they not only from time to time devised improvements in their own methods of closing in on their aim, but they struck out suggestions of inquiry into what occurs in other kinds of groups than the economic. Both directly and indirectly they cleared the way for an enlargement of their field of operations in the directions presently followed by the sociologists. Just as the economists implicitly raised and tried to answer the question, What are the actual phenomena of cause and effect within the whole range of economic groupings? so a little later the sociologists began to feel the urge of the related questions, What are the actual phenomena of cause and effect throughout the whole range of human groupings, in other words throughout the whole range of human society?

In certain respects, as far as it affects sociology, the outcome of the British move toward objectivity associated with the names of Adam Smith, Ricardo and Malthus is more evident in the German than in the British succession. At the close of the 18th century German thinking about economic relations had reached a dead centre. German ideas had been temporarily stabilized by «cameralism,» a peculiar and highly developed body of theory about every phase of action within the state. (Consult Small, 'The Cameralists'). This system of ideas and of practice had been developing since 1555. It did not correspond in its subdivisions with later academic definitions of the social sciences. It started not as general theory but as formulation of administrative expediency. It set forth with the frank purpose of subordinating everything within the control of the state to the state's problem of existence. The central question to which cameralism elaborated answers was: The ruler being all-powerful over his territories and his subjects, what policies, and what details of practice in pursuance of the policies must he adopt, in order to make his rule most secure at home, and in order to provide most abundant means of asserting himself against other rulers? It would require but little reflection to prepare against surprise at what happened. Under the circumstances of the time, this question necessarily led to answers which amounted to prescribed programs covering the entire outward life of the subjects of German rulers. It soon became evident to the advisers of those rulers, and to the administrators of their states, that their problem involved not merely physical factors, but that it was a question of training the whole population for all the different sorts of useful work of which human beings are capable. From generation to generation the men who developed cameralistic theory and practice saw more and more clearly that if the rulers of German states were to command abundant resources, they must rule over resourceful people. This meant that the people must be trained physically, mentally, morally and technically. In the end, therefore, cameralistic theory covered everything in the lives of the citizens, from farm work to religious worship. The machinery for administering this theory grew more and more complex. In detail its organization differed in one state from that in another. Its main purpose was everywhere the same, viz., to make the people as amenable as possible to all the discipline necessary to insure maximum performance of all the physical, mental and moral processes tributary to the strength of the ruler.

It need not be pointed out that this program involved dealing, from this special point of view, with every sort of activity which has since come under the attention of political science and political economy in their latest forms. In so far as cameralism dealt with economic questions in the later sense, it treated them as matters primarily of the state, not of individuals. German economic theory, therefore, was collectivistic in the highest degree. Only incidentally, and in a wholly subordinate degree, was it individualistic. It was a theory of, for and by the government.

This cameralistic system contained the germs of all subsequent German administrative theory, and suggestions of much that was later developed into fundamental economic doctrine. Its centre of attention may be said to have occupied its original prominence only to the time of Sonnenfels (1765). From that date until the third decade of the 19th century there was an interim of barrenness in German economic thinking. This was in spite of the fact that an occasional book of some merit was produced; for example, Büsch, of Hamburg, on the circulation of money ('Geldumlauf').

The one point of departure from which it is possible to get a true view of the development of economic theory in Germany is that the first half century of German political economy was essentially not German at all; it was English. This period falls roughly within the dates 1820–70. During all this time the German economists were unconsciously breaking with all the national precedents for their particular kinds of work, and were trying to do a radically un-German thing. They were first of all doing their best, in their own division of labor, to substitute objectivity for fragmentary knowledge and premature conclusions, but they were trying to do it in an English way. They were not merely trying to graft an English branch upon a German tree. They were trying to make English roots grow in German soil, and bear more abundant and useful fruits than native stocks. If they had succeeded, the English roots would have driven out German roots. German controlling economic ideas would have changed from collectivistic to individualistic.

This fact goes far toward resolving the confusion of German economic theorizing between 1820 and 1870. During all this time the economic group of German thinkers were in dead earnest in their drive after objectivity, but the pass-key to their procedure is that the prevailing spirits among them were all the while trying to naturalize strange gods. For the theoretical and practical state-collectivism which reached its culmination in the theory and practice of Frederick the Great in Prussia and Maria Theresa in Austria, they tried to substitute the so-called theory of «economic liberalism,» or «economic determinism.» Whichever of these two variants of an identical underlying conception was most prominent in specific cases, it relegated the state very largely to a passive or negative rôle, and it made individual initiative paramount. In short, the economic theorizing which held the centre of the stage in Germany between 1820 and 1870 was violently un-German in its presuppositions. It was that unfortunate excerpt from Adam Smithism which passed by way of Ricardo into circulation as the «science» of political economy; and in German hands its implications were worked out to a degree of refinement never surpassed and hardly equalled in England.

If space permitted, it would be illuminating to cite particulars in which the classical economists, both in England and in Germany, by what amounted to a trial and error process, tested every conceivable way of accommodating facts to the classical presuppositions. With each variation of the attempt they confirmed convictions which later transformed certain men into sociologists. (For example, List and the entire «Zollverein» movement, about 1840; the so-called «Historical School,» Roscher, Knies, about 1850; Prince-Smith and the «Manchesterists» of the Volkswirthschaftlicher Kongress, about 1860; the «Austrian School,» Carl Menger, Böhm-Bawerk, about 1870; the professorial socialists, or the Ethical School, Schmoller, Wagner, Verein für Socialpolitik, about 1870; the «Sociological School,» to be mentioned later, about 1880). As each contending sub-hypothesis under the leading assumptions failed to vindicate itself as the one missing clue to the mystery of economic relations, the certainty was approaching that some one would see in these failures the fact that economic groups are not effects of single causes but of multiple causation; that economic groups do not exist in a vacuum; that they are affected by some of the same influences which work in other groups, some of which influences are transmitted from other groups to economic groups, and are sometimes more decisive for economic groups than so-called economic factors proper. It was a foregone conclusion that when these observations were made on the basis of the experience of economists, they would stimulate someone to experiment with a new apparatus of group-analysis. This probability was confirmed in the case of some of the sociologists.

We may indicate this factor in the evolution as follows: Judged by subsequent events, and expressed in the most summary form, political economy became a forerunner of sociology because, however defined and however conducted, political economy devoted itself more and more effectively to critical analysis of that portion of social phenomena which seemed to the economists to fall within their appropriate field of view. Regardless of the question which had to be reconsidered over and over again, as to the validity of their ideas about their special field, and regardless too of the specific facts which they collected, and of the peculiar doctrines which the various theorists derived from the facts, by the very refinements of analysis through which they attempted to get at all the meanings of their phenomena the economists set a pace, and furnished suggestions for imitation, which could not have remained without influence upon other men who were interested in other species of group phenomena. Simply because the type of human group which forms «the market,» whether in the most generalized or in the most localized sense, is only one of myriads of types of human groupings, it was only a question of time when there would be imitators of the economists who would devise ways of applying equally searching analysis to many types of human activities not primarily and immediately, at all events not exclusively and finally activities of the market. This then is the main aspect in which the evolution of economic thinking since 1800 concerns sociology. In a word, it seems to have been necessary that a type of thinkers should have been developed who had become keen for analysis of the operations of the market; and as we shall observe in the next paragraph, another type keen for analysis of men's actions under the political and legal aspects, before a type of scholars could develop with ability to perceive that men are not fully analyzed when they have been thought of only under the economic, the political and the legal aspects. In fact, the sociologists were recruited very generally from either the historical, the economic or the political faculties. Our main thesis at this particular stage of the exposition is that the economists prepared the way for the sociologists, and partly assured their coming, by working out an apparatus for objective exhibit of economic processes as they really are. In so far as the sociologists derived immediately from the economists, it was by cherishing the spirit of group-analysis, and by turning this animus to application upon other than economic groups.

Even before the middle of the 18th century, there were among the cameralists writers who seem to have been almost within sight of the beginnings of sociology in the present sense. Examples are Gerhard, 1713, and Zincke, 1742. (Consult Small, 'The Cameralists,' pp. 175 and 249). The most effective prospecting for a future sociology however was done in Germany, at about the middle of the 19th century, by a series of political scientists. These men seem to have had very little to do with one another, and we do not know whether they were actuated by impulses received from a common source. Several of them, at all events, hit upon a similar if not an identical problem, and it was in substance the same problem with which the men in Germany, England and the United States who called themselves sociologists began their work 20 or more years later. Von Mohl, one of the most notable of these pre-sociologists, reviews the movement and furnishes a bibliography of it as it had developed up to 1855. ('Geschichte und Literatur der Staatswissenchaften,' Vol. I, pp. 69–110). Von Mohl is himself typical of this movement at its best, and we may use him as the most available index of its character. The very title of his first chapter affects an American sociologist as a generation ahead of its time. It reads: «The Sciences of the State and the Sciences of Society» («Die Staatswissenschaften und die Gesellschaftswissenschaften»). The contents of the chapter confirm the impression of modernness. It turns out that the author was in the bonds of that mystical conception of the state from which the Germans are not yet delivered, and he placed in antithesis with the state an equally mystical concept «society»; yet his challenge to analyze the concepts «state» and «society» might very well be celebrated as one of the beginnings of sociology. He proceeds after this fashion: «Only recently have we come to the clear conception that the community life of men is by no means exhausted by life in the state, but that between the sphere of the individual personality and of the organized unity of popular life there is a collection of intermediate life phenomena which also have community objects as their purpose, which do not have their origin from the state or through it, although they are in existence in it, and that these are of the highest significance for weal and woe. These two areas of thoughts and theories, which for more than two thousand years have seemed to be similar, or at most have been regarded as part and whole, have at length proved themselves to be essentially different, and must also be treated separately, so that in the future they will exist side by side, as distinguished but coequal divisions of human knowledge. . . . The science of society must now be founded and developed. In particular its limits with respect to the science of the state must be determined. This . . . not merely for society, but almost as much also for the state and the theory of the state. . . . Of independent works about society there is not a word in the older schools of philosophic writing down to the time of Kant. In this entire literature there is not a single work which has attempted to grasp in their essential nature the life circles outside of the purpose and organism of the state, and to think of them as a whole.» Thereupon von Mohl names numerous books and monographs which began to appear after

1797 in Germany, and beginning with Montesquieu in France, which betrayed a certain disappointing appearance of having seen the need of a «science of society» in distinction from a science of the state. After noticing the type of writers on society whom he calls «essentially not social philosophers but social partisans» (Saint-Simon, Fourier, Robert Owen), and after referring to numerous political theorists who had been approaching the real problem as he saw it, of whom the most notable was Ahrens (‹Cour de droit naturel,› 1837, and the maturer rendering of his peculiar idea in ‹Die organische Staatslehre,› 1850), von Mohl at some length outlines his own conception of the needed «science of society.» This scheme is impossible, and need not be noticed further, except by way of repetition that it was an honest groping after the sociological problem which later emerged. Because of the attention which Americans have given to Treitschke as a prophet of German world-power, more than one kind of interest attaches to the fact that Treitschke's entrance upon his academic career was marked by his publication in 1859 of a monograph in which he claimed to have given its *reductio ad absurdum* to von Mohl's argument for a new science of society (‹Gesellschaftswissenschaft, ein kritischer Versuch›). Treitschke discusses particularly the proposals of Ahrens and von Mohl. He asks whether it is really necessary, as such men contend, either completely to reconstruct political science or to create a new doctrine that shall totally displace it. He reaches his reply by inspecting in turn the groups which von Mohl had used as illustrations, and as to each of them he reaches virtually the opposite conclusion to that of von Mohl, viz., Treatment of this group belongs in political science, and can be adequately provided by political science. With the exception, however, of tribal and ethnic groups, certain economic strata («Nähr-Wehr-und-Lehr Stand»), the educated and the uneducated, religious communities, «voluntary associations of all sorts,» and the family, the groups which he considers are so obviously political that with reference to them the conclusion is not surprising. It was easy to show that each of the groups not primarily political has numerous and vital relations to the state. Nor was it difficult to make it appear to friends of an established cult who did not want a rival, that a rival would be superfluous. It was plausible that all the relations of these groups to the state could be treated best by the established «science of the state» and that facts about these groups which did not interest «the science of the state» were not worth scientific notice. There is a tone of assurance, therefore, in Treitschke's manner throughout the monograph which indicates his belief that he was forever laying the bogy of a «science of society.» In fact, however, in order to reach his negative conclusion he had advertised the existence of groups which he named and others which he did not name. He had featured facts about these groups which could not be exhausted by political theory. We cannot prove that Treitschke's influence actually stimulated anyone to follow up the study of human groups. It is certain that he did not prevent such study, and he unconsciously contributed to demonstration that it was needed.

While it is impossible, in the present state of our knowledge, to make out precisely how the circuit was at last closed between all these stimuli and the minds of the men who actually won a place in social science for a new method of investigation, it is easy to make out the period after which the sociological continuity was unbroken. It has been almost undisputed tradition among the sociologists that August Comte, who is supposed to have coined the word, is also the «founder» of sociology (‹Cours de Philosophie Positive,› ed. of 1869, Vol. IV, pp. 185, 263 and 412. 1st ed. published 1839). Herbert Spencer began to be acquainted with Comte's philosophy in 1853–54, but he asserted that his only indebtedness to Comte, was «the indebtedness of antagonism» (‹Autobiography,› Vol. I, p. 517). ‹Preussische Jahrbücher› (Vol. IV, 1859, p. 279), contains a very intelligent digest of the Comtean system, with the editorial note: «Our readers will be glad to be informed about a thinker who has hitherto been very little known in Germany.» This note is confirmed by the fact that in the section in which he discusses the lack of analysis of society in French literature, von Mohl mentions Montesquieu and Rousseau, but does not name Comte (‹Geschichte und Literatur der Staatswissenschaften› I, 76, 1855). It would be profitless to discuss the question whether Spencer in England or Schäffle in Germany would have been as successful as each was in launching a new method if Comte had never written. It is at all events beyond dispute that the publication of Spencer's plea, ‹Study of Sociology,› beginning in 1872, and the maturing of his ‹Principles of Sociology,› between the years 1874 and 1885, mark the permanent arrival of sociology in England and the United States. Schäffle's work in four volumes, ‹Bau und Leben des socialen Körpers› (first vol., 1875, remaining three vols., 1878, 2d ed. 2 vols., 1896) bears a similar relation to sociology in Germany. We had reference above to Schäffle and his followers when we referred to «the sociological school» of German economists. In his textbook on political economy, published in 1861, Schäffle had begun to exert a modifying influence, from the standpoint which he afterward located more precisely, upon prevailing economic theory. The second edition of this book (1867) and the third (1873) bore the title, ‹The Societary System of Human Economy› (‹Das gesellschaftliche System der menschlichen Wirthschaft›). In the light of later developments it reads like the author's involuntary warning of his approaching secession.

This historical survey would be misleading if it left the impression that the impulses which converged at the points just indicated, and which, as we shall see, spread from these points as rapidly expanding programs, were driven exclusively by the scientific interest. It may be that sentimental philanthropic impulses did more than the strictly scientific temper to bring sociology into existence. Here are to be cited men, first, of the Rousseau-Diderot succession, then of the type of St. Simon (1760–1825) and Fourier (1772–1837), in France; such theorists as the Utilitarians, from Bentham to John

Stuart Mill, then such as Robert Owen, Ruskin, Maurice, Kingsley and Robertson in England; the socialists of all countries, the advocates of «social policy» (Verein für Socialpolitik) in Germany; a group of earnest so-called «social scientists» and especially certain types of philanthropists in the United States, who industriously advocated «the improvement of social conditions.» Presently the activities of this latter type of people became conclusive proof to other types of people that there was sore need of more searching study into social conditions. This conviction enlisted its quota for sociological research in the scientific sense. (Consult Small, 'General Sociology,' pp. 36 sq., and Small, 'Fifty Years of Sociology in the United States,' *American Journal of Sociology,* Vol. XXI, pp. 721–864). For striking evidence of the way in which these philanthropists affected one of the men who later had a conspicuous part in developing general sociology consult Sumner, 'What Social Classes Owe to Each Other' (1883).

Description.— Since we have seen how sociology got a name and a place, the question remains, What sort of a thing is this that is so named and placed? The only valid answer is still essentially historical. From the time of Spencer and Schäffle sociology has been more a steadily developing mode of thinking than an entity conforming to a statical description. This is almost equally true of the more strictly generalizing type of sociology characterized in our original formula, and of the numerous techniques for concrete application of scientific knowledge which also use the name sociology. Confining ourselves now to the former, the early sociologists felt a woe-is-me if they did not succeed in getting a vision of human society as a whole. Instead of feeling satisfaction with the conventions of social science, they were impressed with the futility of everything that had been accepted so far as scientific exposition of human experience. Comte's dictum that the root of evil in the European world was the «anarchy of fundamental ideas,» might have been chosen as their slogan. They were convinced that the only way of removing the confusion in men's minds about social relations must be *achievement of a controlling conception of human society in its entirety.* Without apparent hesitation about the chances of convincing the world, they gave themselves to the task of framing a conception that would be justified by the facts. With differences of detail they believed that human society the world over, past, present and future, makes up some sort of a unity. They believed that parts of this whole, or incidents within the operations of this whole, are to be understood only as they are assigned to their actual places and connections subordinate to the whole. All the variations which have become parts of the main tendency of sociological theory since 1875 have started from some form of this presumption. At the time when this tendency entered upon its permanent course the most potent reconstructive factor in all science was Darwinian biology. It would have been wonderful if the attempts to visualize society in all its dimensions had not come under this virile influence. In fact, they were not only influenced but they were over-influenced. Until well into the 20th century the strength of the sociologists was very largely applied, first, to debate with one another and with social scientists of the older types about classification of the sciences, and about claims between these older possessors and the sociological intruders to equities in scientific territory; second, to elaboration, attack upon and defense of schemes to exhibit the wholeness and the operations of human society as an *organism,* analogous with biological organisms.

A curious case under the first head is a monograph of 80 pages published in 1903 as a part of the Twentieth Annual Report of the Bureau of American Ethnology. When the monograph was written its author, J. W. Powell, was director of the bureau. The title reads: 'Sociology, or The Science of Institutions.' Major Powell says (p. lx): «I classify the sciences of sociology as *statistics, economics, civics, historics* and *ethics,* . . . my purpose being classification only, . . . pleasure, welfare, justice, expression and opinion are concomitant; one cannot exist without the other, hence there can be no sociology without *esthetology, technology, philology* and *sophiology.*»

Under the second head, the schemes of Spencer and Schäffle were essentially similar. They were structures purporting to comprehend all societary relationships as analogues of the structure and functions of physical organisms. On the whole, all of the men who approached the problem in the same way (Lilienfeld, Fouillée, Isolet, Worms, etc.) merely proposed shadings of detail in the conception. Although American sociologists as a rule have regarded the conception as more useful pedagogically than scientifically, and although use of biological analogies in either sense has rapidly lost favor, progress of sociology toward academic recognition, both in Europe and the United States, has been seriously embarrassed by the widely prevalent impression, among other misconceptions, that sociology is merely a name for amateurish dallying with remote and imperfect likenesses between physiological and social relations. While the sociological division in the drive toward objectivity in social science was in danger of exhausting itself in attempts to resolve human experience into symbolic or literal biology, a powerful corrective was introduced into American thinking by the publication of Lester F. Ward's 'Dynamic Sociology' (1883; 2d ed., 1897, identical with the first, except that a new introduction reviews the progress of sociology to date. Ward's «mental autobiography,» 'Glimpses of the Cosmos,' Vol. III, pp. 146 sq., contains an illuminating account of the incubation of the book, from 1869, especially of its relations to Comte and Spencer). For nearly a decade the work seemed to have been still-born. Then scattered signs began to appear that it was making its way. Ward was by profession a botanist. He was an unhesitating evolutionist. Combined with the novelty of much in the book, these two facts gave it significance. Herbert Spencer's rendering of evolution, especially as he was understood to carry it out in his system of sociology and in his *laissez faire* dogmas in politics and economics, went far toward establishing the belief that evolutionism and mechanical fatalism are identical. Ward was the first physical scientist to get a hearing for the contradictory doctrine that evolution ascended one step in the scale with the differentiation of mind: and that it foreshadows the ultimate control of physical forces by psychic forces. Although the further significance of the book was not recognized at once, it virtually called for the transformation of sociology into social psychology. While Ward's psychological method was impossible, he heartened American sociologists to assume at once an affirmative answer to the question which has not ceased to embarrass British sociology, as to whether evolution would permit any reckoning upon mental influences at all. In fact, with all their differences of detail, from the time that a few Americans began to call themselves sociologists they were practically of one accord in the belief that the distinctive and decisive trait in human society is that it is somehow or other a play of mental factors. At the same time Ward was a conspicuous illustration of a crudity, not yet entirely outgrown by sociologists, which was common to all the earlier social scientists of the generalizing types. Each of them more or less consciously cherished an ideal of a complete system of social science, in most cases to be called by the name of the respective dreamer's division of social science. This version projected a structure of knowledge in which there would be a place for everything of importance in human affairs, and in which everything of importance would have been fitted into its place; a scheme of mental architecture which should faithfully reflect the totality of human experience. Each of the philosophies of history, Comte's «positive philosophy,» Spencer's «synthetic philosophy,» and John Fiske's «cosmic philosophy» illustrates the general proclivity. Ward's system was primarily a cosmic philosophy, and his sociology was a more particular account of mundane processes within this entire planetary order. The best conspectus available of American, and to a certain extent of European sociological opinion while this type of thinking had not yet surrendered to influences which were already potent within it, is afforded by a series of papers read at the Saint Louis Congress of Arts and Sciences in 1904. Consult Proceedings, Vol. V, pp. 787–888; Giddings, ‘Concepts and Methods of Sociology’; Vincent, ‘The Development of Sociology’; Ratzenhofer, ‘The Problems of Sociology’; Tönnies, ‘The Present Problems of Social Structure’; Ward, ‘Evolution of Social Structure’; Thomas, ‘The Province of Social Psychology’; Ross, ‘The Present Problems of Social Psychology.’ Practical aspects of social theory at the same period are set forth in Vol. VII of the Proceedings.

We have implied that the Saint Louis Congress marked a stage in the development of sociology. The chief variant which rapidly gained influence in sociological ways of thinking after that point, may be characterized in general as a tendency to diminish attention to structural aspects of social relations and to increase attention to functional phenomena. The predominance of statical views in sociology had always retarded development of dynamic conceptions which were implicit in the more obvious interpretation. In the nature of things this shifting of emphasis was inevitable from the moment that mental factors in social functioning began to receive attention. A social psychology was in process of differentiation long before it was recognized as a distinct division of labor. The men whose present treatment of social psychology bears least resemblance to Ward's will scarcely fail to recognize him as the first important American adventurer into this type of inquiry. The first American book which bore upon its title page the phrase «social psychology» was written by a psychologist (J. Mark Baldwin, ‘Social and Ethical Interpretations,’ 1897). Not a few books which at the time of publication were appraised, both by author and public, chiefly with reference to some other element in their contents, now appear to have done their best service in stimulating consciousness that there can be no solution of social problems without resolving the mysteries of transmission of mental influence. When Simon N. Patten published his ‘Theory of Social Forces’ in 1896, he classed himself as an economist. He was in fact discovering himself and disclosing himself as a daring pioneer in social psychology. Giddings' ‘Principles of Sociology’ (1896) was accepted chiefly as a proposal in social architecture. The extraordinary attention which it has received all over the world is due fundamentally to the fact that it presented psychological aspects of the problem of society with unusually challenging force. (For digest of Giddings' doctrines, and references to his other works, consult Northcott, ‘The Sociological Theories of Franklin H. Giddings,’ *American Journal of Sociology*, Vol. XXIV, p. 1, 1918). Thomas' brief monograph, ‘The Scope and Method of Folk Psychology’ (*American Journal of Sociology*, Vol. I, p. 434, 1896), may be regarded as a prospectus of a division of labor, previously organized in Europe, which has had a large share in reshaping the primal conceptions and the methods of sociology. Notable in this connection are Sumner, ‘Folkways’ (1907); Thomas, ‘Race Psychology: Standpoint and Questionnaire, with Peculiar Reference to the Immigrant and the Negro’ (*American Journal of Sociology*, Vol. XVII, p. 725, 1912); and Thomas, ‘Source Book for Social Origins’ (1909).

Meanwhile a tool had been tacitly adopted into our sociological technique which more than any single instrument has tended to stabilize our procedure. It was the use of the concept denoted by the term «interest,» or some equivalent, as the leading clue to the activities of *socii* composing groups, or of groups considered as correlations of *socii*. The term «valuation» has certain advantages over the term «interest» as an expression of the idea. The essential thing is that the motivation of activities in human groups is traced to preferences in the minds of people, and that qualitative and quantitative analysis of these «interests,» «valuations,» «preferences,» with determination of their proportions in the particular combination in question, has become the crucial operation in social interpretation. This method has been implicit at least as a partial recourse in all attempts to explain human nature. It had become more or less systematic in the program of many sociologists before it was published in the form of an elaborated method. The author who most appropriately marks this stage in the development of sociology is Gustav Ratzenhofer, at the time of the completion of his work an officer on the retired list of the Austrian army, with the rank of Feld-Marschall-Lieutenant. Ratzenhofer's life from early years was that of a soldier. As he rose in rank his outlook became more and more political. He was obliged to study the conditions, first and foremost within the empire, then in countries in political relations with the empire, which served as reasons for the existence of Austrian armies. As this experience matured, it crystallized into an ethic, a sociology, and a political philosophy with a strong set toward political science. Ratzenhofer's chief contribution to sociology is to be found not in his later books, in which he formulated his more general theory of ethics and sociology, but in the work which is most nearly related to political science, ‹Wesen und Zweck der Politik. Als Theil der Sociologie und Grundlage der Staatswissenschaften,› (3 vols., 1893). The author's most important additions to the method exemplified in this work were in the single volume entitled, ‹Die Sociologische Erkenntnis. Positive Philosophie des socialen Lebens› (1898). Ratzenhofer's method, so far as contained in these two works, may be described as a psychological survey chiefly generalized from, or illustrated by groups visible in and around the Austrian Empire. The outstanding peculiarity of the two works, considered as a single essay in sociological methodology, is the relatively large proportion of concrete material cited in support of the more generalized conclusions. That Ratzenhofer has had so little influence on the Continent can be explained only by the traditional attitude of European scholars toward men not of their gild. The most complete account of his method available in English is a digest, with annotations, in Small, ‹General Sociology,› pp. 183–396. The tables, «Typical Interests Within States,» on page 252, and «Contemporary Conflicting Interests in Austria,» page 393, present at a glance the scheme of the inquiry.

It is not improbable that greater changes may occur in the next decade in the character of sociology than in any previous decade. At the present moment it manifests six leading tendencies. The first of these appears as «Methodology»; criticism of points of view, working presumptions, attitudes toward other divisions of labor and details of operative programs. Of this tendency the present paper may serve less as an example than as an index. Second, the various forms of «group psychology.» Of these we may distinguish (a) the line of development from McDougall, ‹An Introduction to Social Psychology› (1909), to Ellwood's volume with the same title (1917); (b) the variety represented by Cooley, ‹Human Nature and the Social Order› (1902), and ‹Social Organization› (1909). Most prolific at the present moment is (c) that variety which generalizes types of group reaction in selected situations from large numbers of historical and contemporary instances. Examples are Ross, ‹Social Control› (1901), the same author's series of papers in *American Journal of Sociology,* beginning Vol. XXI, p. 433, published in book form under the title ‹The Principles of Sociology› (1919); and Cooley, ‹Social Process› (1918). Third, a tendency for which no name has been generally adopted, but for convenience we may call it *social analysis.* It is an elaboration of social psychology through selection of particular social groups or social situations, and study of cause and effect as there presented. «As a distinctive method it involves the detection, description and causal explanation of all the factors entering into the social situation, or determining the behavior of the group studied. Social analysis is purely scientific in its interest, and is not immediately concerned with social action. Social laws discovered by social analysis are, however, of value for the determination of fundamental policies of social construction.» (Burgess). The most conspicuous example of this method is Thomas and Znaniecki, ‹The Polish Peasant.› (Helen Culver Found.) Two of the five volumes announced have appeared (1918). The «methodological note» of 86 pages and the introduction to volumes I and II mark the line of farthest advance at present in plans for this kind of research.

Fourth, *Social Survey.* It has been said that social analysis is to social survey as research in physics to a civil engineer's orientation. «The survey arose from the effort to substitute fact for belief as a basis of social action. As a distinctive method the survey involves study, by application of standards determined by experts, of the problems, institutions and social agencies of a community, as a basis for formulation of a constructive policy or program.» (Burgess). «It is the application of scientific method to the study and solution of social problems which have specific geographical limits and bearings, plus such a spreading of its facts and recommendations as will make them, as far as possible, the common knowledge of the community and a force for intelligent co-ordinated action.» (Harrison, ‹Community Action through Surveys,› p. 11, Russell Sage Found.). Social survey is so much more immediately available for practical purposes than either of the foregoing tendencies, that its bibliography deserves special prominence. On the methodological side, in order of publication, Gillin, ‹Application of the Social Survey to Small Communities› (American Sociological Society Proceedings, 1911); Riley, ‹Sociology and Social Surveys› (*American Journal of Sociology,* Vol. XVII, May 1911); Kellogg, Harrison and others, ‹Social Surveys› (Russell Sage Found. 1912); Elmer, ‹Social Surveys of Urban Communities› (1914); Park, ‹The City, Suggestions for the Investigation of Human Behavior in the City Environment› (*American Journal of Sociology,* Vol. XX, March 1915); Gillin, ‹Social Survey and its Further Development› (American Statistical Association Publications, September 1915); Burgess, ‹The Social Survey: A Field for Constructive Service› (*American Journal of Sociology,* Vol. XXI, January 1916); Aronovici, ‹The Social Survey› (1916); Harrison, ‹Community Action through Social Surveys› (Russell Sage Foundation 1916). On the operative side: Booth, ‹Life and Labour of the People in London› (9 vols., 1892–97); Rowntree, ‹Poverty: a Study of Town Life› (1902); Kellogg (Director), ‹The Pittsburgh Survey› (6 vols., The Russell Sage

Foundation 1904–14); Burns (Director), 'Cleveland Education Survey' (25 vols., Cleveland Foundation 1915); Harrison (Director), 'The Springfield Survey' (3 vols., Russell Sage Foundation 1918).

Fifth among contemporary variations of sociology is also without a conventional name. It is most frequently referred to as the *case method*, or *social diagnosis*. «It is the differential method of case work, as it has developed in family and individual rehabilitation, as carried on by charitable organizations. As a distinctive method, case-study involves determination of all the factors present in a given case, so far as is necessary in order to prescribe remedial treatment.» (Burgess). Consult Richmond, 'Social Diagnosis,' Russell Sage Foundation, 1917.

Sixth, *concrete programs* for amelioration and construction. Charles R. Henderson included all these in the term *social technology.* In his mind they were «social polity» passing into application. They are sometimes indicated by the more popular phrase *social engineering* (Earp. 'The Social Engineer,' 1911). Discussion of the movements thus suggested would require a treatise. They have a range from kindergarten to international reconstruction. Like all other technical problems after their kind, they draw at need from the whole extant body of knowledge and apparatus of execution. In so far as colleges and universities have provided instruction about these problems, it has most frequently been scheduled either in the department of economics or of sociology. This assignment obviously corresponds more to academic convenience than to intrinsic relationship.

What then is the technique which is now the distinctive equipment of the sociologist? Primarily it is a *collection of categories.* First of all, these are categories of rationalization. They are sub-species in the gradations within the genus of thought forms which reflect human relations in the large. They begin with the most general, such as «group,» «socius,» «group structure,» «group function,» «group forces,» «group process,» «group interest,» etc. These most general categories pass into subordinate forms which reflect descending orders of generality in observed group phenomena. The scale passes from least specific terms to most specific through categories for rough preliminary classification of groups. The variations of these are innumerable, because there is no limit to the number of principles which may be made the basis of classification. Thus, for certain purposes, objectivity is served by analysis of groups strictly on the basis of quantitative classification (Simmel, 'Soziologie,' Chap. II, «Die quantitative Bestimmtheit der Gruppe.» Id. «The Number of Members as Determining the Sociological Form of the Group,» *American Journal of Sociology,* Vol. VIII, pp. 1 and 158). For references to all of Simmel's papers on this subject which have been published in English, vid. *American Journal of Sociology,* Vol. XX, p. 629, note. For other purposes, objectivity is served by applying one or more of the gradations of categories on the basis of race, industry, religion, culture, politics, language, etc. It is obvious that these less general categories need not necessarily in the first instance be original with the sociologists. The contrary is probable. They are more likely to be categories worked out by anthropologist, ethnologist, economist, etc., and taken over by the sociologist whenever his problem involves the previous work of other divisions of science. For example, few men within the ranks of the sociologists have exerted more influence upon sociological method than the anthropologist, Lewis Henry Morgan ('The League of the Iroquois,' 'Ancient Society,' etc.), or the English professor of jurisprudence, Sir Henry Maine ('Ancient Law,' 1861; 'Village Communities,' 1871; 'Early History of Institutions,' 1875; 'Dissertations on Early Law and Custom,' 1885, etc.). These categories do not of themselves constitute sociology, any more than the categories «multiplicand,» «quotient,» «cube root,» constitute mathematics. The uses of the categories constitute sociology. The technique accordingly involves, second, a body of procedure. This varies, in accordance with the particular character of the problem undertaken, from the most abstract dealing with questions of epistemology and methodology to the most concrete questions of juvenile courts or milk supply. The generic factor in common, from one end of this scale to the other, is reference of the problem to its group attachments, instead of treating it as something isolated from the human process as a whole. The technique involves, third, control of an enormous accumulation of knowledge about social reactions. A generation ago it was urged with much pertinence that colleges and universities should not give academic standing to the new claimant «sociology,» until it could justify recognition by presenting an organized body of knowledge. Meanwhile the sociologists have accumulated an appalling volume of insights into social relationships which had not been noticed by previous scholars. And the search with the new equipment is hardly begun. It remains true that organization of this knowledge is far from adequate. (Vid. Hayes, 'Sociology as Ethics,' *American Journal of Sociology,* Vol. XXIV, p. 289). The most successful attempts to gather sociological results into textbook form are, on the side of social organization and operation, Blackmar and Gillin, 'Outlines of Sociology' (1915); on the side of ethical evaluation of social processes, Hayes, 'Introduction to the Study of Sociology' (1915); on the side of social psychology, Bogardus, 'Essentials of Social Psychology' (1918).

In view of the relation which we have indicated between political science and sociology, it is equally astonishing and unfortunate that for nearly a generation legal institutions were left almost wholly outside the range of American sociologists' vision. No one without legal training could venture successfully into the field thus neglected, and for a long time sociological methods found no favor with American legal scholars. The situation has notably changed since Roscoe Pound, now Dean of Harvard Law School, became the leading attorney in this country for an attitude toward legal construction precisely opposite to that of Savigny in his controversy with Thibaut in 1814. This factor has already had such influence with law faculties, and among social scientists in general, that quite possibly the most important sociological advances in the next generation will proceed from the basis of legal study. Consult Pound, 'The Scope and Purpose of Sociological Jurisprudence,' 23 *Harvard Law Review,* 591, 25 *Harvard Law Review,* 140–489; 'The End of Law as Developed in Legal Rules and Doctrines,' 27 *Harvard Law Review,* 195; 'The End of Law as Developed in Juristic Thought,' 27 *Harvard Law Review,* 605, 30 *Harvard Law Review,* 201. Somewhat less technical than the papers of Dean Pound are the three volumes in the Evolution of Law Series, compiled by Professors Kocourek and Wigmore of the Northwestern University Law School, 1918. The separate titles are (1) Sources of Ancient and Primitive Law. (2) Primitive and Ancient Legal Institutions. (3) Formative Influences of Legal Institutions.

To recapitulate: Although the earlier social scientists never confessed it in quite this way, it is easy to see now that all of them, including the sociologists, who indulged at all in speculations about the larger aims of science treated the aggregate of human events, past and present, like a collection of structural elements; and they assumed that the task of social science, their own part of it in particular, was to organize all the miscellaneous events which have filled the career of mankind from the beginning up to the present into a schematic combination, in which each occurrence would have its appropriate place, and in which the relation of each occurrence to every other occurrence would be evident.

We may frankly admit that sociology would not have been born when it was, and its early history would not have been what it was, if this conception of scientific possibility had not stimulated a few men to risk the attempt to realize this conception, which men before them in other branches of science had dismally failed to vindicate. At the same time, we must insist upon the truth that, in this respect, the sociologists were merely experimenting with a chimera which had over and over again lured social scientists of all the older types.

But just as the more objective historians of the latest half century have fortified themselves against suspicions of identity with the so-called philosophers of history, so the sociologists of to-day are more or less consciously and explicitly repudiating the conception just indicated, which they or their immediate predecessors unblushingly published a generation ago. The totality of human experience is too big, too complicated, too unexplorable, to be exhibited by the human mind as a complete and inclusive system of articulated parts, with each event throughout the length and breadth of human experience visibly bearing its actual relation to all the other events. The thought of such comprehension as something within the reach of human intelligence can no longer be entertained by a responsible mind. Our ideal at present is discovery of typical, qualitative relationships of antecedent and consequent, of cause and effect, of harmony and disharmony, of stability and instability, of constructiveness and destructiveness, in as many different types of human groups as possible. We entertain hopes of reaching certain quantitative expressions of the same relations, but about these we are much less sanguine. This is on the purely scientific side, antecedent to whatever we may feel authorized to undertake on the side of social control or social art.

We understand that there are enormous differences in the feasibility of this ideal, dependent for instance upon the remoteness or nearness in space or time, or upon the simplicity or complexity of the group immediately in question. We believe that from generation to generation men may, and with progressive use of available means for accumulating knowledge of human conditions they will become more sophisticated and competent to control their situation in the interest of increasing development of human capacities. Within recent years the advances of social science in general, and of sociology in particular, have manifested increasing deference to the conception set forth in this review. Indeed, no account of sociology would be authentic unless it were an exposition of it as a multitude of mental processes converging toward and operating in accordance with substantially this description.

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SOCK, originally a low shoe or slipper, worn by the Greeks and also by the Roman women, who had them highly ornamented. They were likewise worn by comic actors, the buskin, or cothurnus, being used in tragedy; hence sock and buskin are used figuratively as equivalent to comedy and tragedy. Now a short stocking.

SOCORRO, sō-kŏr'rō, Colombia, a town in the province of Santander, 150 miles northeast of Bogotá. Its buildings are insignificant; the climate is hot and insalubrious. The manufactures are cotton goods and straw-plaiting. There is considerable trade in sugar, cotton and indigo. Agriculture is the chief occupation of the region. Pop. 12,000.

SOCOTRA, or SOKOTRA, sō-kō'trä, an island in the Indian Ocean, belonging to Great Britain, 150 miles northeast of Cape Guardafui. Its area covers 1,382 square miles. It consists of mountains, covered by forests, rising to heights sometimes of 4,500 feet; plateaus almost destitute of vegetation, fertile valleys and coast lands. The climate is warm and very dry. The finest aloes of the world are grown here; also dates. Livestock raising is an important industry. The people are a mixed race (negro, Arab and Indian), but present two distinct types. In 1876 the English government entered into a treaty with the ruling sultan, declaring a suzerainty and in 1886 annexed the island. English and German expeditions have investigated its natural features and geology, which is of great interest, being considered a fragmental area of an early continent, perhaps a part of Africa; with later intrusions due to volcanic action. Of 47 species of shell found, 44 were indigenous to the island. Tamarida is the principal town. Pop. (est.) 10,000.

SOCRATES, sŏk'rạ-tēz, Greek philosopher: b. Athens, in 469 B.C.; d. 399 B.C. His father, Sophroniscus, was a sculptor, and Socrates himself followed this occupation for a time. His mother, Phænarete, was a midwife. In his youth he received the education prescribed by the laws, and also made himself acquainted with geometry and astronomy. That he had listened to Anaxagoras or Archelaus is only reported by untrustworthy authorities; Plato accounts for his master's acquaintance with the works of the former by supposing that he had read the work written by that philosopher. According to Xenophon he was familiar with the doctrines of other natural philosophers, although he did not accept them. Plato represents Socrates as saying that, while still very young, he met Parmenides, the most important of the Eleatic philosophers, who was then advanced in years, as the latter was expounding his doctrines. A material influence on his philosophical development was exercised by the Sophists, to whose discourses he occasionally listened, and with whom he frequently entered into conversation. Excepting in connection with his philosophical career, only a few circumstances of his life are known. He served as a hoplite or heavily armed soldier in the campaign of Potidæa (432–429 B.C.), where he excelled his fellow soldiers in the ease with which he endured the hardships of a winter campaign, distinguished himself by his valor, saved the life of his friend Alcibiades and resigned to that youth the prize of honor which was awarded to his own bravery. He fought at the battle of Delium (424), and according to one account saved the life of Xenophon, while according to another his own retreat was protected by Alcibiades. In 422 he marched with Cleon against Amphipolis. On two memorable occasions he came boldly to the front in political life. After the battle of Arginusæ (406) 10 naval officers were publicly arraigned for neglecting the sacred duty of burying the slain in consequence of a violent storm. The clamor for their condemnation rose so high that the court wished to proceed in violation of all legal forms; but Socrates, the presiding judge on that day, refused to put the question. He soon after showed that he could withstand tyrants as well as the populace. He was summoned by the Thirty to proceed with four other persons to Salamis to bring back Leon, an Athenian citizen who had retired thither to escape the cruelty and rapacity of the new government. He alone refused, while the others obeyed the order. He declined taking further share in public affairs, giving as a reason the warnings of an internal voice, a divine Mentor, of which he was wont to speak.

In the writings of the disciples of Socrates he appears almost always as a man advanced in years, such as they themselves had known him. With remarkable physical strength and endurance, he trained himself to coarse fare, scanty clothing, bare feet, and indifference to heat or cold, aiming thus to reduce the number of his wants, as a distant approach to the perfection of the gods, who want nothing. He had a flat nose, thick lips, prominent eyes, bald head, squat figure and ungainly gait, so that Alcibiades likened him to an uncouthly sculptured Silenus containing within the images of the gods. He brought into thorough subjection his naturally impetuous appetites and irascible temper and has been called the most illustrious example in history of the moral conscience, and the creator of moral science. But though a sage he was wholly removed from the gloom and constraint of asceticism; he indeed exemplified the finest Athenian social culture, was a witty as well as a serious disputant, and on festive occasions would drink more wine than any other guest without being overcome. Of his wife Xanthippe, all that has passed into history is that she bore him three sons, that she was an arrant shrew, and that he married and endured her for self-discipline. Among the most distinguished of his companions were Plato, Xenophon, Crito, Euclid of Megara, Antisthenes, Aristippus, Phædon, Æschines, Cebes and Alcibiades. He devoted his life especially to the education of youth and for the accomplishment of this end he relied on *erōs*, love, which, without excluding its sensuous element, he refined and utilized as an instrument in the conduct of souls and the common development of his thoughts and those of his listeners. Socrates was firmly convinced that he was charged with a special religious mission. He believed he was called by the Deity to strive, by means

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of his teaching and life, after a revival of moral feeling, and the laying of a scientific foundation for it. For this reason he had been warned against participating in public affairs by the internal divine voice already mentioned. Relying, too, like his countrymen, on divine intimations by dreams and oracles, he believed that his mission had been signified to him by these. Aristophanes, in his comedy of ‹The Clouds› (first represented in 423), attributes to Socrates not only traits of character and opinions which really belonged to him, but also Anaxagorean doctrines and sophistical tendencies.

In 399 B.C., formal accusation was brought against the philosopher in the following terms: «Socrates is guilty of crime, first, for not worshipping the gods the city worships, and for introducing new divinities of his own; next, for corrupting the youth. The penalty due is death.» These are virtually the same charges as laid against him by Aristophanes more than 20 years earlier. His accusers were Meletus, a young dramatic poet, little known, and personally almost a stranger to Socrates and who is said to have joined in the accusation because he felt himself injured by Socrates' demonstration of the ignorance of poets respecting their art; Anytus, a rich leather-dealer and influential demagogue, who was displeased with the depreciatory judgment of Socrates respecting the Athenian statesmen and politicians; and Lycon, a public orator, who felt injured by what Socrates said of the orators. The trial took place before a dikastery, or law-court composed of citizen judges, like our juries, but far more numerous; the number present on this occasion has been variously set down at 500, 501, 557, and 567. His bold defense, which appeared to his judges as presumptuousness, is preserved by Plato, under the title of the ‹Apology of Socrates.› He dwelt on his mission to convict men of their ignorance for their ultimate benefit; declared himself a public blessing to the Athenians; assuring them if his life was spared he would continue in the same course; and regarded the approach of death with utter indifference. To his judges his philosophical reflections seemed a violation of those ethical and religious foundations of the Athenian state, which the restored democracy was endeavoring to re-establish. The former intimacy of Socrates with Alcibiades and with the hated tyrant Critias, led to a mistrust of his doctrines and purposes. Yet the condemnation was voted by only a small majority, some read three and others 30. But since after his condemnation he would not acknowledge himself guilty, by expressing an opinion as to the punishment he should receive, but declared himself worthy, on the contrary, of being fed at the Prytaneum as a benefactor of the state, and at last only on the persuasion of his friends agreed to a fine of 30 minæ, he was condemned to death by an increase of 80 votes. The execution had to be delayed 30 days, until the return of the sacred ship which had been sent to Delos on the periodical Theoric mission. Every morning his wife and three sons, together with his companions and friends, assembled in his cell, and he conversed with them as he had been wont to do. In his solitary hours he composed a hymn to Apollo and versified several of the fables of Æsop, his first attempts at poetical composition. His friends formed projects for his escape and Crito, his old and tried friend, undertook to persuade him to comply with their wishes. He considered it, however, his duty as a citizen to obey the laws, though they were badly administered and would not consent. Early on the morning of the fatal day his wife and friends met in his cell to spend the last hours with him. Xanthippe was much affected, and showed her grief by loud cries; Socrates made a sign to Crito to have her removed, as he wished to spend his last moments in tranquillity. He then talked with his friends, first about his poem, then concerning suicide, and at last on the immortality of the soul. The manner in which the assembled friends, in the alternation of joyful admiration and profound grief, lauded him as one who, by the divine appointment, was going to a place where it must fare well with him, if with any one; how he departed from them with the one wish, that in their care for their true welfare they would cherish in their memories all his sayings; and how he designated the transition to the life beyond death as the true recovery from a state of impurity and disease, is set down in lively and affecting colors by his great disciple Plato, in the dialogue ‹Phædo.› The approach of twilight at length admonished them that the hour had come. He took the hemlock cup, calmly and slowly drank the poison. He then walked up and down the apartment, trying to console his weeping friends. When it became difficult to walk he lay down upon his couch, and before his heart ceased to beat he exclaimed: «My friends, we owe a cock to Æsculapius.» He then covered himself up with his cloak and calmly expired. «Thus died the man,» says Plato in his ‹Phædo,› «who of all with whom we are acquainted was in death the noblest, in life the wisest and most just.»

In their accounts of the life of Socrates the two principal authorities, Xenophon and Plato, substantially agree, although the Platonic picture is sketched with the more delicate pencil. As to their reports of his doctrine, it is first of all undoubtedly true that Plato in his ‹Dialogues› generally presents his own thoughts through the mouth of Socrates. But in a certain sense his ‹Dialogues› can nevertheless serve as authorities for the Socratic teaching, as the groundwork of the Platonic philosophy is contained in the Socratic, and as it is possible, in general, though not in all cases in detail, to discriminate between the Platonic and Socratic elements. Plato was cautious enough not to be led by his love of idealization too far from historic truth; in some of his compositions he remains almost entirely faithful to it, and in others puts those doctrines which Socrates could not have professed into the mouth of other philosophers. Xenophon wrote the ‹Memorabilia› and the ‹Symposium› not so much in the spirit of a pure historian as in that of an apologist; but his honorable defense of Socrates demands from us entire confidence in his historic fidelity, so far as his intention is concerned. But it must be acknowledged that as much cannot be said of his intellectual qualification for an exact and comprehensive understanding of the Socratic philosophy. Xenophon appears to attribute too unconditionally to Socrates the tendency natural to himself to connect all scientific activity with a practical purpose, and he thus gives too small a place to the dialectic of Socrates as compared with his ethical teachings. The brief statements of Aristotle respecting the philosophical doctrines of Socrates are very valuable, since they are purely historical, and relate to the most important points of his teaching. The previous philosophies consisted of vague speculations on nature as a whole, combining cosmology, astronomy, geography, physics, metaphysics, etc. Socrates had given much attention to these subjects and arrived at the conclusion that the knowledge he had gained was of little practical value. Astronomy might have a certain value in navigation and in the measurement of time, and so should be learned to some extent by the pilot and the watchman; geometry was useful when confined to land-measuring; arithmetic might be useful in many of the affairs of daily life, and so on; but the speculations of philosophers, from Thales downward, as to the origin of all things out of fire, water, air, etc., he regarded as profitless, nay, as impious even. «Do these inquirers,» he would ask, «think that they already know human affairs well enough that they thus begin to meddle with divine? Do they think they shall be able to raise or calm the winds at pleasure, or do they simply seek to gratify vain curiosity?» The gods managed the operations of nature after their own pleasure, and refused to submit them to invariable laws of sequence, such as could be discovered by human study; the only means of knowledge permitted was sacrifice, prayer and the consultation of the oracles. Men's strivings after knowledge should be directed to the human relationships as involving men's practical concerns. Self-knowledge, the fulfilment of the requirement of the Delphic Apollo, «Know thyself,» is the condition of practical excellence. External goods do not advance their possessor; to want nothing is divine, to want the least possible brings one nearest to divine perfection. Virtue is capable of being taught, and all virtue is in truth only one; no man is voluntarily wicked, all wickedness simply resulting from ignorance. The good is identical with the beautiful and the useful. Cicero's well-known saying that Socrates called philosophy down from the heavens to earth and introduced it into the cities and houses of men, compelling men to inquire concerning life and morals and things good and evil, indicates in terms substantially correct the progress of philosophy in Socrates from the cosmology and physics of his predecessors to anthropological ethics. He possessed, however, no complete system of ethical doctrines, but only the living instinct of inquiry, and could, therefore, naturally arrive at definite ethical theorems only in conversation with others. The fundamental thought in his political doctrine is that authority properly belongs to the intelligent — to him who possesses knowledge. The good ruler must be, as it were, a shepherd to those whom he rules; his business, his «virtue,» is to make them happy. Socrates did not favor the appointment of officers by popular suffrage and by lot. He defends the belief in the existence of gods on teleological grounds, arguing from the structure of organized beings, and founding his reason on the general principle that whatever exists for a use must be the work of intelligence. The wisdom which is present and rules in all that exists determines all things according to its good pleasure. It is distinguished from the other gods as the ruler and disposer of the universe. The gods, like the human soul, are invisible, but make known their existence unmistakably by their operations.

It is reported that soon after the death of the great philosopher the Athenians regretted their sentence and that to expiate their crime a brazen statue, the work of Lysippus, was dedicated to his memory. Yet a more general revulsion of opinion in favor of Socrates seems first to have taken place in consequence of the labors of his scholars. That some of the accusers were put to death and others exiled is probably a fable, founded perhaps on the fact that Anytus, banished in all likelihood for political reasons, died in Heraclea, on the Pontus, where in later centuries his tomb was still pointed out. Consult Burnet, J., «Thales to Plato» in 'Greek Philosophy,' Part I (London 1914); Forbes, J. T., 'Socrates' (New York 1905); Gomperz, T., 'Greek Thinkers' (New York 1905); Hyslop, J. H., 'Ethics of the Greek Philosophers' (New York 1904); More, «Socrates» in 'Shelburne Essays,' 6th series (New York 1909); Wright, W. C., 'A Short History of Greek Literature' (New York 1907); Zeller, E. G., 'Socrates and the Socratic Schools' (tr. by Richel, O. J., 3d ed., London 1885).

SOCRATES, Scholasticus, Greek Church historian: b. Constantinople, about 380; d. after 440. Little is known of his life except that he lived in Constantinople and was an advocate. His history, written about 439, embraces the period 306–439, and is written in seven books still in existence. Together with the histories written by Sozeman and Theodoret it forms one of the three histories of the period extant, and was written before the other two, whose writers were evidently familiar with it. While not a history in the accepted sense of the word it is nevertheless a valuable source of information for the period it covers. It is not the work of a man of deep learning, nor of astute knowledge of either church or state, but it is nevertheless of unquestionable honesty and straightforward in character. It was edited by Stephanus (Paris 1544); Reading (Cambridge 1720); Hussey (Oxford 1853; reissued by Bright, 1878); Oxford school edition, after Reading's version (1844). Consult also Geppert, F., 'Die Quellen des Kirchen Historikers Socrates Scholasticus' (1898).

SODA, Commercial Production. Sodium carbonate in the form of soda ash is the principal form in which commercial soda is produced although some of it is immediately transformed into caustic soda. The main source is salt and limestone treated by the Solvay process, but a small amount is made from natural sodium carbonate chiefly from water of Owens Lake in southeastern California. Some is also saved from waste water of pulp and paper mills and a few mills make sodium carbonate by an electrolytic process employing carbon dioxide generated in lime kilns.

Production of soda ash in 1918 was 1,390,628 short tons, valued at $35,635,520, or about the same tonnage as in 1917, valued at $38,028,000. This does not include the soda ash converted by the producers into caustic soda or sodium compounds to an amount estimated at 664,000 short tons in 1918 and 482,000 short tons in 1917. The total value of all sodium compounds produced in the United States in 1917 is estimated at $74,000,000. In 1917 eight companies made caustic soda from soda ash (358,081 tons), and 28 companies made 137,663 tons by reduction of sodium chloride by electrolysis, in most cases utilizing the chlorine gas liberated. Some of the manufacturers use a part of their product for technical processes of various kinds. Exports of soda ash in 1918 were 119,218 short tons, valued at $7,805,550, sent mostly to Japan, Canada, Argentina, Brazil, Australia, Cuba and Chile. Considerable soda is imported into the United States, the total value in 1917 being about $74,000. Soda ash is used for making glass, soap, dyestuff, explosives and as washing materials; sodium compounds have replaced potassium wholly or in part in many technical processes. In 1917 there was sold 174,217 tons of cooking soda or sodium bicarbonate valued at $5,292,374 and 77,939 tons of washing soda valued at $1,698,528. Caustic soda is used for making soap, pigments and wood pulp, in purifying oils and fats, in mercerizing cotton, as a general cleanser (lye) and in making dyes and phenol, the latter used for making such explosives as ammonium picrate and lyddite.

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SODA NITRE, native sodium nitrate, $NaNO_3$. It is a colorless, deliquescent mineral, crystallizing in the rhombohedral system, but usually massive in beds. It occurs near Lovelock's, Nev., and near Calico, Cal., and in vast beds in Chile, where it is extensively mined. It is one of the most important fertilizers (q.v.), and is also used in the manufacture of nitre.

SODA WATER, a beverage consisting of water charged with carbon-dioxide gas under pressure, so that it appears aërated. It received its name from the fact that in its early manufacture it was generated from sodium bicarbonate with an acid. It is usually flavored with a sweet syrup of fruit or some chemical substitute, and a great variety of «soft» drinks are compounded and sold at soda fountains, which are common adjuncts of drug stores in the United States.

SODALITE, a widely-distributed rock-forming mineral. It is a common constituent of volcanic rocks, especially elæolite-syenites, in which it occurs in isometric crystals or in grains or massive veins. A sodalite-trachyte abounds in the island of Ischia, near Naples, while fine, white crystals occur in the bombs of Vesuvius. It is best known, however, as a cleavable-massive mineral of rich azure-blue color. It is found thus at Litchfield, Maine, in Ontario and British Columbia, and is well adapted for use as an ornamental stone. Its hardness is 5.5 to 6; specific gravity 2.14 to 2.34; lustre vitreous or greasy; composition, aluminum and sodium orthosilicate with sodium chloride.

SODALITE GROUP includes sodalite, hauynite, noselite and lazurite, all minerals crystallizing in the isometric system and of unusual interest chemically because they are isomorphous compounds of an orthosilicate with the salt of another acid or with a haloid. Their relations to the garnet group have been developed by Brögger.

SODDY, Frederick, English chemist: b. Eastbourne, 2 Sept. 1877. He was educated at Eastbourne College, the University College of Wales, at Merton College, Oxford, and studied under Sir Ernest Rutherford at Montreal and under Sir William Ramsay at London. In 1900–02 he was demonstrator in chemistry at McGill University; lecturer in physical chemistry and radioactivity at Glasgow University in 1904–14; and has since been professor of chemistry at the University of Aberdeen. He has specialized in the field of radioactivity. He was elected a Fellow of the Royal Society in 1910; and in 1913 he received the Cannizzaro Prize of the Accademia dei Lincei, Rome. Author of 'Radioactivity, an Elementary Treatise from the Standpoint of the Disintegration Theory' (1904); 'The Interpretation of Radium' (1909); 'Matter and Energy' (1912); 'Chemistry of Radio-elements' (1912–14).

SODEN, Hans Karl Hermann, BARON VON, German Protestant theologian: b. Cincinnati, Ohio, 16 Aug. 1852; d. 1914. He was educated at Esslingen, Urach and at the Theological Institute at Tübingen. He was archdeacon at Chemnitz in 1883–86, and was thereafter pastor at Jerusalemkirche, Berlin. From 1893 he was also associate professor of New Testament exegesis at the University of Berlin. He made a lifework of the collection and comparison of New Testament manuscripts. He wrote 'Der Brief des Apostels Paulus an die Philipperbriefe' (1890); 'Reisebriefe aus Palästrina' (1898); 'Die wichtigsten Fragen im Leben Jesu' (1904; 2d ed., 1909); 'Die Schriften des neuen Testaments' (1904); 'Urchtistliche Literaturgeschichte' (1905), etc.

SODIUM (from «soda,» which word was used in the Middle Ages to designate alkaline substances in general), a metallic element, first prepared by Davy in 1807, by the electrolysis of molten caustic soda, or sodium hydroxide. In 1808 Gay-Lussac and Thénard showed that the metal can be prepared by reducing the hydroxide with finely divided metallic iron. Brunner, about 1823, obtained metallic sodium by reducing sodium carbonate with carbon; and Deville, in 1855, improved Brunner's process so as to make it commercially practicable for the manufacture of sodium on the large scale. Deville's method, as practised in recent times, consists in distilling a mixture of 30 parts of calcined carbonate of sodium, 13 parts of coal and 7 parts of lime; the reduction taking place at a temperature of about 2,500° F., the metal being given off in the form of a vapor, which is then passed into a condenser and allowed to liquefy and solidify. As thus obtained, sodium contains numerous impurities, most of which may be removed by straining the melted metal through linen under rock oil, at a temperature of about 212° F. Deville's process of manufacture was used almost exclusively until about 1886, when the well-known Castner process came into use. Castner reduced sodium hydroxide by a combination of carbon and iron, prepared by coking a mixture of pitch and finely divided iron; the coked mass having approximately the composition of Fe_2C, and being commonly known as «carbide of iron,» although it is doubtful if this name is chemically justifiable. The Castner process possesses many practical advantages over that of Deville, and hence it rapidly came into almost universal favor. A considerable quantity of metallic sodium is now prepared by the direct electrolysis of molten sodium hydroxide, or sodium chloride (common salt). Sodium possesses powerful reducing properties, and the metal is used in the preparation of silicon, boron, aluminum and other elements whose reduction by means of carbon is either difficult or impossible. Deville, in fact, developed his method of preparation with the object of using the sodium that it yielded in the subsequent preparation of metallic aluminum (q.v.); and for many years the commercial supply of aluminum was practically all prepared by reducing aluminum compounds with metallic sodium. Since the development of the Hall process for the manufacture of aluminum by electrolysis, metallic sodium has lost a considerable part of its former great commercial importance.

Sodium is a silvery-white metal, hard at 0° F., ductile at 32°, wax-like at ordinary temperature and pasty at 120°. It melts at 207° F., and boils at about 1,700°. It oxidizes with great facility, and must be kept under benzene, or petroleum, or some other fluid that is devoid of oxygen, or in a neutral atmosphere of hydrogen, coal gas or some other substance for which it has no affinity. It may be prepared in the form of lustrous, octahedral crystals, white in color but with a rosy sheen. Like potassium, it dissolves in anhydrous liquid ammonia (NH_3), forming a blue solution from which the metal may be again obtained by the evaporation of the solvent. Sodium has a specific gravity of about 0.98, a specific heat (in the solid form) of 0.273, and a coefficient of linear expansion (Fahrenheit scale) of 0.0000395. At the freezing point of water, the specific electrical resistance of sodium is about one-eighteenth of that of mercury.

Chemically, sodium is a monad. It has the chemical symbol of Na (from «natron,» the Spanish name for native carbonate of sodium), and its atomic weight is 23.00 if $O = 16$, or 22.82 if $H = 1$. It forms a multitude of compounds, many of which are of great importance in the arts. The chloride of the metal occurs in great abundance in nature, as common salt. (See SALT). Its formula is NaCl, and it is extensively used as a source of sodium in the preparation of other compounds of the metal. Sodium nitrate, $NaNO_3$, commonly known as «Chile saltpetre,» occurs native in large quantities in Chile, and as it is much cheaper than the native nitrate of potassium, it is used largely in the manufacture of ordinary nitre; chloride of potassium and nitrate of sodium reacting together to form chloride of sodium and nitrate of potassium. (See NITRE). Sodium bromide, NaBr, which is extensively used in medicine as a sedative, is prepared by adding bromine to a solution of pure sodium hydrate, NaOH, till the liquid becomes slightly yellow. It is then evaporated to dryness, and strongly heated to decompose the bromate, $NaBrO_3$, which is formed simultaneously with the bromide; after which the residue is redissolved and crystallized by evaporation.

Two oxides of sodium are known. Sodium monoxide, Na_2O, may be prepared in several ways, but it is doubtful if it has yet been obtained in a state of absolute purity. It is formed when metallic sodium is oxidized in dry air or dry oxygen, at ordinary temperatures; but it is said that some small trace of moisture must be present, in order for the oxidation to proceed. This monoxide is a grayish solid, having a powerful affinity for water, with which it combines to form sodium hydroxide (NaOH), as indicated by the equation $Na_2O + H_2O = 2NaOH$; the combination being attended by the development of a considerable quantity of heat. The monoxide may also be prepared by heating dry sodium hydroxide with metallic sodium, its formation in this case being attended by the liberation of hydrogen. Sodium peroxide, Na_2O_2 (also called the «dioxide»), is of considerable commercial importance, owing to its increasing use as a bleaching agent. It is prepared by passing a stream of dry air slowly over melted sodium at a temperature of about 570° F., the sodium being thereby converted into a mixture of the monoxide and peroxide. When all the sodium has been oxidized, the air current is replaced by a stream of dry oxygen gas, which transforms the monoxide that is present into peroxide. Sodium peroxide is soluble in water, but the solution readily decomposes with the formation of sodium hydroxide and the liberation of oxygen, as indicated by the equation

$$Na_2O_2 + H_2O = 2NaOH + O.$$

The bleaching effect of the peroxide is due to this liberation of oxygen from the aqueous solution.

Sodium carbonate, Na_2CO_3, commonly known simply as «soda,» or, in the impure form, as «soda ash,» is one of the most important chemical substances known. It was formerly prepared mainly from the ashes of sea-plants, in the same way that carbonate of potassium is obtained from the ashes of land plants; but at the present time it is prepared almost exclusively by chemical means, from common salt. For many years the only method in use for its manufacture was that invented by Leblanc, during the first French Revolution, in the latter part of the 18th century. In 1838 the «ammonia» process was patented in England, but although this promised to be superior to the method of Leblanc, certain practical difficulties were encountered which proved to be fatal to its success, until they were overcome by E. Solvay, who erected the first commercially successful «ammonia process» plant near Brussels, in 1861, and for whom the process itself has since been named. A certain proportion of the output of sodium carbonate is also manufactured by electrolysis; but the greater part is manufactured by the Solvay process though the Leblanc method is still used to a considerable extent.

Leblanc Process.— In the Leblanc method for the manufacture of sodium carbonate there are two successive operations to be performed. The first of these, which is known as the «salt cake» process, has for its object the transformation of chloride of sodium into sulphate of sodium. For this purpose the salt (sodium chloride) is heated with sulphuric acid in large covered iron pans; hydrochloric acid being liberated in the course of the reaction, as indicated by the equation

$$2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl.$$

The hydrochloric acid vapors which are thus generated are passed through a «scrubbing tower,» which contains coke or brick, over which a stream of water is kept running, the hydrochloric acid dissolving in the water, and constituting an important by-product. The crude sodium sulphate, Na_2SO_4, is the «salt-cake» from which this part of the process takes its name. Pure crystallized sodium sulphate (containing 10 molecules ot water of crystallization) constitutes the familiar substance known as «Glauber's salt,» which is used in medicine as a saline purgative. The salt-cake, as obtained by the first operation, is subsequently treated by the «black ash» process, which is so called on account of the color of the immediate product that it yields. Ten parts of the salt-cake are mixed with 10 of limestone (calcium carbonate) and seven and a half of coke, and the mixture is heated in a reverberatory furnace, technically known as a «balling furnace.» The carbon of the coal reduces the crude sodium sulphate to the form of sulphide of sodium, Na_2S, in accordance with the equation

$$Na_2SO_4 + 2C = Na_2S + 2CO_2;$$

while the sulphide, thus produced, is converted into sodium carbonate and calcium sulphide (CaS), by the limestone ($CaCO_3$), in accordance with the equation

$$Na_2S + CaCO_3 = Na_2CO_3 + CaS.$$

In practice these two reactions go on together, and the final mixture of calcium sulphide, sodium carbonate and such impurities as may be present is the so-called «black-ash,» or crude soda. Calcium sulphide is insoluble in water in the presence of lime, and hence it is easy to separate the sodium carbonate from the mass by solution and subsequent crystallization. «Crystallized soda,» or «washing crystals,» consists of sodium carbonate crystallized with 10 molecules of water.

The Ammonia (or Solvay) Process.— The ammonia process for the manufacture of sodium carbonate depends upon the fact that when bicarbonate of ammonia, $H(NH_4)CO_3$, is added to a solution of common salt ($NaCl$), bicarbonate of sodium ($HNaCO_3$) and sal ammoniac (NH_4Cl) are formed, as indicated by the equation

$$NaCl + H(NH_4)CO_3 = HNaCO_3 + NH_4Cl.$$

In practice, this operation is carried out by saturating a solution of common salt with ammonia gas (NH_3), and then passing carbon dioxide gas into the solution, under pressure. Bicarbonate of ammonium is formed in the solution, but is immediately broken up with the formation of bicarbonate of sodium, as indicated by the foregoing equation. We may, therefore, regard the reaction as taking place directly in accord-indicated by the equation

$$NH_3 + CO_2 + NaCl + H_2O = HNaCO_3 + NH_4Cl.$$

The sal ammoniac, being quite soluble, remains in solution; while the bicarbonate of sodium, being relatively insoluble, is obtained in the solid form. The bicarbonate, when dried and strongly heated, gives off carbon dioxide gas and is converted into the normal carbonate, as indicated by the equation

$$2HNaCO_3 = Na_2CO_3 + CO_2 + H_2O;$$

the carbon dioxide thus freed being again used in the first stage of the process. The sal ammoniac that is formed during the process is recovered from solution by evaporation, and the ammonia that it contains is liberated by the action of lime or magnesia. The reaction in the case of magnesia is

$$2NH_4Cl + MgO = MgCl_2 + 2NH_3 + H_2O;$$

the ammonia being used over again, just as the carbon dioxide is. The magnesium chloride, $MgCl_2$, may be thrown away, or it may be resolved, by the action of heat, into magnesia and hydrochloric acid, as indicated by the equation

$$MgCl_2 + H_2O = MgO + 2HCl;$$

the hydrochloric acid so obtained constituting a by-product, just as it does in the Leblanc process.

Sodium carbonate is used in the arts for the greatest variety ot purposes. When a stream of carbon dioxide is passed through a saturated solution of the carbonate, sodium bicarbonate (or hydrogen sodium carbonate), $HNaCO_3$, is formed; and, as has already been stated, the bicarbonate may be again transformed into the carbonate by the action of heat. Sodium bicarbonate is used in the manufacture of baking powders, in the preparation of effervescing drinks, in medicine and for many other purposes.

Sodium hydrate, sodium hydroxide or «caustic soda,» may be prepared by boiling lime (calcium hydroxide) with sodium carbonate, the reaction being

$$Ca(OH)_2 + Na_2CO_3 = CaCO_3 + 2NaOH.$$

The carbonate of calcium that is formed at the same time is practically insoluble, and by allowing it to subside, and evaporating the supernatant liquid to dryness, sodium hydroxide is obtained in the form of a white fibrous mass. The hydroxide melts at a red heat, deliquesces in the air, and absorbs carbon dioxide gas even from the air, passing then into the carbonate. Sodium hydroxide is formed when metallic sodium is thrown upon water, the water being decomposed with the liberation of free hydrogen, according to the equation

$$Na + H_2O = NaOH + H.$$

The heat developed by this reaction is not in general sufficient to ignite the liberated hydrogen. (Compare Potassium). Sodium hydroxide is intensely alkaline, and large quantities of it are used in the manufacture of soap, in the mercerizing of cotton and for many other purposes.

Of the remaining compounds of sodium, the borate, silicate, phosphate and hyposulphite may be especially mentioned. Borax, or sodium tetraborate, $Na_2B_4O_7 + 10H_2O$, occurs native, the chief supply of the United States now coming from California. (See Borax; Boron). Sodium silicate, Na_2SiO_3, commonly known as «water glass,» is prepared by melting quartz sand with sodium carbonate. It is soluble in water, and is largely used in the manufacture of artificial stone. Three phosphates of sodium are known, phosphoric acid (q.v.) being tribasic. The one which is understood when «sodium phosphate» is mentioned without qualification is the hydrogen di-sodium phosphate, whose formula is HNa_2PO_4. Hyposulphite (or thiosulphate) of sodium, commonly known as «hypo,» has the formula $Na_2S_2O_3 + 5H_2O$, and is prepared by passing a stream of sulphur dioxide gas through a solution of sodium sulphide and sodium hydroxide, and then crystallizing the solution by evaporation. It is extensively used in photography for «fixing» negatives and silver prints; its action depending upon its power of dissolving such parts of the silver salts as have not been reduced by the action of light, or the developer. «Hypo» is also used by paper makers as an antichlor, for neutralizing the last traces of the chlorine that may be left in the pulp, after it has been bleached with «chloride of lime.»

In general, the salts of sodium are closely analogous in all respects to those of potassium, so that for most purposes a salt of either of these metals may be substituted for the corresponding salt of the other one. Salts of sodium that are volatile in the flame of the Bunsen burner communicate to that flame an intense orange-yellow color, and when the light from such a flame is examined through the spectroscope, the color is found to be due to a close pair of lines in the orange-yellow region, which coincide with the «D» lines of the solar spectrum. The light from a flame that is colored by volatile sodium salts is nearly monochromatic, and such flames are, therefore, used in numerous physical experiments, in which the production of light of a single wave-length is desired.

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SODIUM, Production of. See Electrochemical Industries.

SODOM, Apple of. See Apple of Sodom.

SODOM AND GOMORRAH, Palestine, the principal of the five cities, Sodom, Gomorrah, Admah, Zeboïm and Zoar, described in the book of Genesis as the «cities of the plain» of Jordan. According to Gen. xix, they were overthrown on account of the wickedness of their inhabitants, with the exception of Zoar, which was spared at the supplication of Lot. Modern writers are not agreed as to the site of these cities. They have commonly been placed on the south of the Dead Sea, near the Salt Hill of Usdum; but it appears that this is not in accordance with the Scripture narrative, nor with the other references to these cities in the Bible. The site is supposed to be north of the Dead Sea, and visible on the east from a height between Bethel and Ai. Sodom and Gomorrah are commonly used in the allegorical or denunciatory language of the Scriptures as typical examples of extremely wicked communities; hence the word sodomy. See also Dead Sea.

SODOMA, Il, ēl sō-dō'mä, Italian painter known also as Giovanni Antonio Bazzi: b. Vercelli, 1477; d. Siena, 1549. He was noted for his religious and historical works. His best-known pictures are the famous frescoes in the Villa Farnesina in Rome. Consult Jansen, 'Life of Sodoma' (1870).

SOFIA, sō-fē'ä, or **SOPHIA,** Bulgaria, capital of the principality, 310 miles by rail northwest of Constantinople, occupies a plateau of the Balkans. It consists of two distinct sections — the old town and the new town built since 1880. The modern town is suggestive of the French cities; the main streets radiate from the national palace, and are bordered by stucco-covered houses, and fine government buildings, chief of which are the court of justice, national bank and libraries, war department, city hall, consulates and a capacious theatre; and, in the old town, the cathedral and mausoleum of Alexander of Battenberg. There are extensive bazaars and fine baths. On the highest point in the town stand the ruins of an ancient church (and mosque) — Saint Sophia. There are a university for both sexes, with 2,300 students, several churches, a synagogue and a monument to Alexander II of Russia, military and other schools, and a public park. The gypsy quarter lies between the Lion Bridge and the railway station. There is a brisk trade in hides, liquor, corn and wheat. Sofia stands on the ancient site of Ulpia Serdica, and was occupied by the Bulgarians in 809; in 1382 it was taken by the Turks; in the crusade of 1443 was sacked by the Poles and Hungarians, and in 1878 was captured by the Russians, the Mohammedans fleeing. It has been frequently plundered and bombarded, but remains prosperous, developing rapidly as capital of the Bulgarian principality. Pop. about 105,000; with district, 482,000.

SOFT GRASS, a grass, described as velvet-grass in the article Grasses in the United States (q.v.).

SOFT-SHELLED TURTLES. See Turtle.

SOFTAS, sŏf'tąz, pupils who study Mohammedan law and theology in schools attached to the mosques. They are boarded free of charge, the expense being paid from the revenue of the mosques, or from donations made for the purpose. If too poor to provide their own clothing or bedding, it is found for them by the charitable, the support of the softas in their studies being a favorite and pious object of Mussulman generosity. The softas are a most conservative class, and almost fatatical in their adherence to the ancient rules of their religion. They refuse to adopt Western ideas or fashions, and they exert a strong reactionary influence in Turkish affairs. After sufficient study of the Koran, the Sunna, the Arabic language and other Mohammedan learning, they pass an examination which entitles them to be called Khodjas. The term «softas» is also applied generally to the ulemas, imams, and others connected with the mosques. See Mohammedanism; Sunna; Sunnites.

SOFT-SHELL BAPTISTS. See Baptists.

SOHAR, sō'här, Arabia, a seaport on the southeastern coast, on the Gulf of Oman, 165 miles northwest of the capital, Muskat. It is a walled town and its chief buildings are a castle and synagogues. There are iron-foundries and other metal-works, also a considerable weaving industry, and the lands of the vicinity are highly cultivated. As early as the 10th century it was an important centre of trade. In the period extending from the 16th to the 17th century, it was occupied by the Portuguese. Pop. 24,000.

SOHN, zōn, **Karl Ferdinand,** German painter: b. Berlin, 10 Dec. 1805; d. Cologne, 25 Nov. 1867. He studied under Schadow; was appointed professor in the Academy of Düsseldorf in 1832. Among his most celebrated pictures are 'Rinaldo and Armida' (1827); 'Diana and Actæon' (1833); The Judgment of Paris' and 'Romeo and Juliet' (1836); 'Tasso and the Two Leonoras' (1838).

SOHRAB AND RUSTUM, by Matthew Arnold (published 1853), is perhaps the most important classical English poem since Wordsworth. Its theme — the combat of a father with his son in ignorance of their kinship — involves central human relations in love and in war, and gives full scope for pathos, tragic irony, and the classical sense of fate. These are conveyed in 891 blank verse lines of clear and measured narrative, with passages of description and dialogue, full of sonorous names after the manner of Milton, and of elaborate similes and other reminiscences of Homer and the Greek tragic poets; so that the focal and universal theme, which even if unembellished would have appealed to all men, is given every means of evoking in instructed readers the peculiarly classical æsthetic effect of modified remembrance and recognition. Yet the poem does not in the least suggest a cento; its action, which, as an «episode» or rather *epyllion,* takes us at once *in medias res,* carries all off with a masterly epic stride; while perhaps the most celebrated passage — that in which, at the end of the poem, the course of the river Oxus is followed to the sea — is modern in its feeling for the resolution of all human discords in nature's serene disregard of them. Comparison of the narrative structure of 'Sohrab and Rustum' with that of the 'Shah Nameh,' the original of the story, will show Arnold's decisive improvements in compactness, in unity, and in economy of means; comparison with other versions of the same theme, such as the fragmentary Old High German 'Hildebrandslied,' and Mr. W. B. Yeats' play 'On Baile's Strand,' will show the equally decisive superiority of Arnold's poem in universality and human significance.

Samuel Lee Wolff.

SOIL, a term used to designate the superficial portion of the earth's surface composed of broken and disintegrated rock mixed with varying proportions of decayed and decaying animal and vegetable matter (humus). For the entire mantle of unconsolidated material covering the earth's surface and including the soil Merrill proposes the expressive name *regolith,* from ῥῆγος, a blanket, and λίθος, a stone. The soil proper is the upper portion of the regolith. In humid regions as a rule it is easy to trace the gradation from *soil* proper at the surface through *subsoil* to the underlying undecomposed rock. The subsoil is distinguished from the surface soil mainly by a smaller percentage of organic matter and greater compactness, the latter being due to the accumulation of finer particles carried down by percolating water (clay subsoil) or to the formation of *hardpan* resulting from the compacting effect of continued cultivation at a uniform depth or to the cementing action of salts formed in the soil (calcerous and alkali hardpan). Hilgard has shown that on account of the absence of the leaching action of water, the soils of arid regions are often uniform to a great depth, there being little or no distinction between soil and subsoil, although under irrigation and cultivation calcerous and alkali hardpan frequently makes its appearance.

Origin, Formation, and Classification.— Soils have in the main been derived from the solid rock of the earth's crust through the disintegrating (weathering) and transporting action of various agencies, among which are changes of temperature (heat and frost), moving water or ice (glacial action), chemical action of air and water and the influence of animal and vegetable life (including the action of micro-organisms); and since some of these agencies are continually at work the properties of soils are constantly being more or less modified. Soils are grouped according to the method of their formation into two main classes: (1) *Sedentary soils* formed by the weathering of rock *in situ* (residual deposits) or by the extensive accumulation of organic matter as in case of marsh or peat soils (cumulose deposits); and (2) *transported soils* composed of materials transported from other localities than that in which the soil is found by water, ice (glaciers) or wind. Under residual soils Merrill includes such as are composed of «those products of rock degeneration which are to-day found occupying the sites of the rock masses from which they were derived, and immediately overlying such portions as have as yet escaped destruction.» Such soils occur most extensively in the United States east of the Mississippi River and south of the southern margin of the ice sheets of the Glacial Epoch and are typically exemplified in the usually highly colored brown, red and yellow ferruginous clay soils of the southern Appalachian region. The cumulose deposits are typically illustrated in the United States in the Dismal Swamp lands or the muck soil of Florida.

The more important examples of transported soils are *alluvial soils,* familiarly typified in the river bottom lands and deltas like those of the Nile and Mississippi; *æolian soils* composed of materials transported by the wind and typified by the sand dunes of seacoast regions and the characteristic loess of China and other countries; and *glacial drift soils* due to glacial action. Such drift soils cover a large portion of the northeastern and north central United States and are composed of the débris of disintegrated rocks of various kinds brought down from the north during the glacial period. Besides these main types of soils there are several others of more or less importance in the United States, including the soils composed of fine *volcanic ash* found in considerable areas in Kansas, Nebraska, Colorado, Montana and other Western States; *adobe,* a stiff clayey soil distributed in circumscribed areas over a large portion of the arid region of the United States; *gumbo soil,* a compact fine silty soil; and a so-called loess supposed to be of alluvial origin. In practice soils are, as a rule, described simply as gravelly, sandy, loamy, clayey, calcareous, humous or peaty, etc., according to the fineness of the soil particles and the proportions of sand, clay, lime and humus. They are also distinguished as light or heavy, but as so used these terms do not refer to the actual weight of the soil, but rather to the ease with which it is cultivated. Thus sandy soils, which are termed «light» in an agricultural sense, are actually heavier than clay soils, which are considered «heavy» from an agricultural standpoint.

There are almost innumerable gradations of soil types as regards chemical and physical characteristics, so that a satisfactory classification on this basis is very difficult. The Bureau of Soils of the United States Department of Agriculture, therefore, maps and classifies the typical soils of the areas it surveys on the basis of the differences in agricultural value as determined by field observations on «the character of the soil and its relation to crops and vegetation,» supplemented, however, by physical and chemical examinations. Considering the soil mainly as a medium into which plants send their roots and from which they draw a part of their food, it is evident that its agricultural value will depend largely upon the character of the original rocks from which the soil was derived, the degree of fineness to which the material has been reduced, the amount and character of the organic admixture, as well as upon the treatment to which the soil has been subjected and the changes it undergoes under cultivation. The fertility of a soil is, therefore, determined not only by the store of plant food which it contains, but depends to a large extent upon the chemical, physical and biological processes by which this plant food is rendered available to plants. The soil is not only a storehouse of plant food, but a workshop or laboratory in which this food is being constantly prepared for the use of plants, and it is the object of cultivation to promote the processes by which this is brought about. Chemical, physical and biological properties and processes are so intimately associated in soil that it is not always possible clearly to distinguish between them. For convenience of discussion, however, it is desirable to consider them separately.

Chemical Composition and Properties of Soils.— Plants derive all of their ash or mineral constituents and a large part of their nitrogen from the soil, and in order that a soil may produce plants it must contain these constituents in proper proportion and in assimilable condition. Nitrogen is one of the largest and most important constituents of plants. The ash constituents are taken up in comparatively small amounts by plants, but they are none the less essential to their growth. The more important mineral elements of plant food include sulphur, phosphorus, potassium, calcium, magnesium and iron. Apparently sodium, silicon and manganese are also needed by plants. Since the rocks from which soils are derived contain more or less of all the mineral elements it is not likely that any soil will be entirely lacking in any of those required. Their proportion and availability for assimiliation by the plant may, however, vary so widely as to cause wide differences in productiveness. The constituents of soils may be divided into three classes: (1) Active, that is, soluble in water or the root secretions of plants and hence readily available; (2) latent, that is, not soluble in water or root secretions, and hence not readily available, but becoming so in time through natural agencies, by the application of fertilizers or soil amendments, such as lime, marl, etc., or as a result of tillage; and (3) mechanical. The last is by far the largest class, constituting usually from 90 to 95 per cent of the entire mass of the soil, and chemical analysis shows it to be as a rule mainly silica or sand. Hilgard gives the average composition of soils of arid, semiarid and humid regions as determined by ordinary methods of chemical analysis (treatment with strong acids) as follows:

AVERAGE CHEMICAL COMPOSITION OF SOIL.

CONSTITUENTS	Humid region	Semiarid (transition) region	Arid region
	Per cent	*Per cent*	*Per cent*
Insoluble matter	84.17	75.04	69.16
Soluble silica	4.04	8.46	6.71
Potash	.21	.33	.67
Soda	.14	.32	.35
Lime	.13	.70	1.43
Magnesia	.29	.47	1.27
Iron oxide	3.88	2.08	5.48
Alumina	3.66	4.57	7.21
Manganese oxide	.13	....	.11
Phosphoric acid	.12	.21	.16
Sulphuric acid	.05	.02	.06
Humus	1.22	3.24	1.13
Nitrogen in soil	(.12)	.22	.13

It will be observed that the proportions of actual fertilizing constituents — nitrogen, phosphoric acid, potash, lime, etc.— are relatively small. When, however, the amounts per acre are taken into consideration they assume greater importance. An acre of sandy soil to a depth of one foot may be assumed to weigh about 4,000,000 pounds, of loam soil 3,500,000 pounds, of clay soil 3,250,000 pounds. An acre-foot of loam soil of the humid region, having the average composition given above, would, therefore, contain 7,350 pounds of potash, 4,550 pounds of lime, 4,200 pounds of phosphoric acid and 4,200 pounds of nitrogen, amounts sufficient to supply the needs of many crops. It should be borne in mind, however, that these are average figures from which there may be wide departures even in soils of the same type, and that productiveness of a soil as determined by chemical composition depends, as already stated, not so much upon the total amounts of the constituents present as upon their availability for the uses of plants. Ordinarily chemical analysis may show the presence of large amounts of all the necessary fertilizing constituents and still the soil may be unproductive if these constituents are not in a form in which they may be readily appropriated by the plant. Chemical analysis is capable of showing the presence, absence or marked deficiency of any necessary constituent or the presence of harmful substances, but it has not yet reached such a stage of perfection that it can show with absolute certainty the amount of available plant food which a soil contains.

The methods most commonly used for determining the availability of plant food in soils involve the treatment of the soil with a weak solvent, such as 1 per cent citric acid, fifth-normal nitric acid, carbonated water or ammonia chloride solution, which it is assumed approximates the power of plants to utilize the soil constituents. Schloesing, among others, has called attention to the importance of studying the availability of plant food in the soil by means of water extracts, but the Bureau of Soils of the United States Department of Agriculture applying a method based upon the solubility of the soil constituents in water to a large number of productive and unproductive soils of the United States, reached the conclusion that "practically all cultivable soils contain naturally a nutrient solution which varies within comparatively narrow limits with regard either to composition or concentration and which is usually sufficient for plant growth" and that, therefore, there is no obvious relation between the chemical composition of the soil and solution and the yield of crops. The work of others, however, indicate that the growth of plants in the water extracts of soil closely parallel their growth in the soil from which the extracts are made. The recent development of centrifugal, displacement, or pressure methods of obtaining unaltered or but little changed soil solutions in quantity permits of important investigations on this point not heretofore possible.

The availability of the soil constituents depends largely upon the extent to which disintegration has proceeded and the amount of leaching to which the soil has been subjected. Thus in the soils of arid regions in which disintegration has been going on uninterruptedly for ages with no leaching, the soluble salts are always found in large and often in excessive amounts, as, for example, in the so-called *alkali soils,* which are simply soils containing an excess of soluble salts accumulated at or near the surface, and which when this excess is removed, dispersed or otherwise rendered innocuous, are among the most fertile known.

Chemical analysis shows soils to be very variable in composition, and since the processes by which soils are formed and plant food rendered available are continually going on, frequent examinations are necessary if accurate knowledge of the chemical properties of a soil at any given time or of the amounts of plant food becoming available during the period of growth of a plant is to be had. While, as already intimated, chemical analysis must not be taken as an absolute guide to the fertilizer deficiencies and requirements of soils, certain general deductions have been drawn from soil analyses which may be of practical value if applied with discrimination. For example, German authorities classify soils on the basis of their chemical analysis as follows: Soils containing less than 0.05 per cent of either nitrogen or phosphoric acid are considered as poor, those containing from 0.05 to 0.1 per cent moderately rich, 0.1 per cent average or normal, from 0.10 to 0.15 per cent good, and above 0.15 per cent rich; soils containing less than 0.05 per cent of potash are classified as poor, from 0.05 to 0.15 per cent moderately rich, from 0.15 to 0.25 per cent average or normal, and over 0.25 per cent rich; loam soils containing less than 0.1 per cent of lime are classified as poor, from 0.1 to 0.25 per cent moderately rich, from 0.25 to 0.5 per cent average or normal, from 0.5 to 1 per cent good, and over 1 per cent rich; sandy soils containing less than 0.05 per cent of lime are classified as poor, from 0.5 to 0.1 per cent moderately rich, from 0.1 to 0.2 per cent average or normal. Over 0.2 per cent of lime is not often found in sandy soils.

The minimum percentages of the different mineral elements in the soils of the United States which, according to Hilgard, chemical analysis has found to be necessary to the thrifty growth of general crops, may be summarized as follows: Potash may vary widely without material effect but should not as a rule be less than 0.25 per cent. One-tenth per cent of phosphoric acid is adequate and there should not be less than 0.05 per cent of it. The greater the proportions of lime and humus and the less the amount of iron in the soil the smaller the percentage of phosphoric acid required. One-tenth per cent of nitrogen is adequate. Lime should not fall below 0.1 per cent in sandy soils nor 0.6 per cent in heavy clay soils. As a general rule the larger the proportion of lime present the lower the percentages of potash, phosphoric acid and nitrogen required. Magnesia is seldom deficient.* Iron is usually present in abundance. Humus, which modern investigation has shown to be a variable complex of many substances and not a definite compound, may vary widely in amount and nitrogen content. The humus of humid soils usually contains a smaller percentage of nitrogen than that of soils of arid regions. Humus is not only important as a source of supply of nitrogen, but also of other plant food constituents — potash, phosphoric acid, lime, etc. According to Snyder, the proportion of these constituents combined with humus represents to a large extent the amounts available in the soil.

An important property of soils, which is partly chemical and partly physical, is their absorptive power for fertilizing constituents, which prevents these constituents from being lost in the drainage or dissipated in other ways before the plant can utilize them. Of the more important fertilizing constituents soils apparently have the least retentive power for nitrogen (especially in the form of nitrates) and the greatest for phosphoric acid. Soils apparently hold lime less tenaciously than potash, since it has been shown that when potassium chloride is added to a soil the potash is retained by the soil and the lime of the soil passes into the drainage in combination with the chlorine.

Physical Properties and Processes.— The physical properties of soils which are of special importance are color, weight, fineness of division or texture, arrangement of particles or structure, adhesiveness, and relations to heat, gases, water and dissolved solids. The physical properties of soils are to such a large extent inherent that the common practice of selecting soils with special reference to the suitability of their physical properties to the crop to be grown is usually a wise one. Nevertheless good tilth with good water conditions, aëration and temperature, as well as an adequate supply of plant food, which are so essential to productiveness, may be modified and improved to a considerable extent by proper management, culture and fertilizing, and with the improved physical conditions the chemical and biological processes of the soil come effectively into play.

The physical properties of soils depend largely upon the relative proportions of stones, gravel, sand, clay, lime, and organic matter present. Sandy soils are as a rule light colored, dry, warm, of low adhesive power, have little absorptive capacity for moisture and fertilizing matter, and are generally poor. Clayey soils are more adhesive and have a stronger absorptive power for water and fertilizing matter. They are as a rule wetter, cooler and more difficult to work than sandy soils, but are naturally more fertile. Soils containing a considerable amount of humus are dark colored and light in weight and have a strong absorptive power. Hence, humus soils are frequently wet soils. Lime improves the structure of both sandy and clayey soils, hastens the decay of organic matter, corrects acidity and promotes nitrification and other beneficial bacterial activities.

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* According to Loew magnesium salts unaccompanied by a certain proportion of lime exert a toxic effect on plant growth.

The color of soils is determined in most cases by the proportions of organic matter and oxide of iron they contain and is of little importance except that it probably affects in some degree the temperature of the soil (see below).

Soils vary widely in weight, as already intimated. Hall gives the following figures:

WEIGHTS PER CUBIC FOOT OF DIFFERENT KINDS OF SOIL.

	Weight per cubic foot Pounds
Heavy clay	66.4
Sandy clay	80.0
Light loam	76.4
Sandy loam	76.7
Sandy peat	49.0
Light sand	79.2

Texture and Structure of Soils.— The productiveness of a soil depends to a considerable extent upon its texture (fineness of particles) and structure (arrangement of particles). These properties determine largely the circulation of water and gases, the solution and retention of plant food and the growth of roots of plants. Good texture and structure thus enable a poor soil to produce better crops than a more fertile soil of which the texture and structure are not so good. One of the main objects of tillage is to promote better soil texture and structure. These properties are affected to a considerable extent by various fertilizers. For instance, lime has the power of flocculating the soil particles and thus renders soils more porous, while sodium nitrate and many other substances have a tendency to puddle the soil, that is, to keep the particles separate and thus prevent the open floccular structure. Soils containing large amounts of clay and other fine particles are most injured by puddling and hence most benefited by flocculating by means of lime.

Relation of Soils to Heat.— The temperature of the surface soil is subject to the same changes as that of the air, but these changes occur more slowly. The variations decrease as the depth increases until they finally disappear. There are several modifying influences affecting the temperature of the soil. The first of these is color. A dark colored soil is usually warmer than a light colored soil. A soil containing much sand or gravel is as a rule warmer than one containing much clay or humus, as already intimated. Soils exposed so as to receive a large amount of the direct rays of the sun are warmer than those not having such exposure. Probably the most important factor determining the temperature of a soil is its water content. A wet soil is cold. Evaporation is a cooling process, and the heat necessary to carry it on is drawn from the soil, thus lowering its temperature.

Relation of Soils to Water.— The development of plants is impossible without a sufficient supply of water in the soil at all periods of growth. Water is not only an important constituent of plant tissue, but it is of the greatest importance as a solvent and carrier of food in the soil and in the plant. A comparatively small part of that taken into the plant is used to build tissue, the larger part passing out through the leaves by transpiration, which is, however, essential to the healthy growth of the plant. It is estimated that for each pound of dry matter produced in the crop from 250 to 500 pounds of water is drawn from the soil. All soils are capable of absorbing and retaining moisture, but the extent to which they do so varies widely, a fact which is of great importance in determining the mutual adaptability of crops and soils. As a rule the capacity of soils to hold water is proportional to the size of the soil particles, the finer the particles the larger the total surface area of the particles and the greater the capacity for water, although this is not invariably true. King has computed the pore space and surface area of the particles of different kinds of soils as follows:

PORE SPACE AND SURFACE AREA OF PARTICLES IN DIFFERENT KINDS OF SOIL.

KIND OF SOIL	Pore space	Area of surface per cubic foot of soil
	Per cent	*Sq. ft.*
Finest clay soil	52.9	173,700
Fine clay soil	48.0	110,500
Loamy clay soil	49.2	70,500
Loam	44.1	46,500
Sandy loam	38.8	36,880
Sandy soil	32.5	11,000

Coarse sand allows water to run through freely, retaining relatively little, while fine clay absorbs and retains a large amount. The proportion of organic matter is also an important factor in determining the water-holding capacity of soils, the larger the proportion of organic matter the greater the capacity of the soil for holding water. Healthy root development is not possible in a soil saturated with moisture. The most favorable amount of water for plant growth is stated to be from 40 to 75 per cent of that which the soil is capable of holding when completely saturated. Another important factor to be taken into consideration is that soils vary in the readiness with which they give up water to growing plants when the amount becomes limited. Crops can utilize a larger proportion of the water in open, coarse-grained sandy soils than of that in compact fine-grained clay soils. In other words, plants will suffer from drought on compact clay soils containing a proportion of moisture which would be entirely sufficient for their needs on sandy soils. Thus, while sandy soils have a much smaller total storage capacity for water than clay soils, the available water is more nearly equal in the two cases than would at first be supposed. Sachs found that tobacco plants began to wilt when the water content of sandy soil was reduced to 1.5 per cent, of clay soils to 8 per cent and of sand and humus to 12.3 per cent.

Water exists in soils in three different states, which may be termed hydrostatic, capillary and hygroscopic. Hydrostatic water is that which fills the soil spaces and would drain away if given opportunity. Its upper surface stands at a certain level, which is known as the water table. Capillary (or film) water is that which is capable of rising in the soil or of moving from a more moist to a less moist part of the soil under the influence of surface tension without regard to the force of gravity. Hygroscopic water is that which closely surrounds the soil particles, but is not affected by gravity and does not move through the soil under the influence of surface tension. Capillary water is often drawn from the hydrostatic supply and is the most important from the standpoint of plant growth. Hygroscopic water is not of great value to vegetation. Heinrich found that plants begin to wilt before the water content of soils is reduced to the hygroscopic limit.

Soil water when present in sufficient amount is constantly in motion. In case of rainfall, irrigation or the melting of snows, the moisture sinks into the soil, carrying along with it oxygen, carbonic acid, nitric acid, ammonia, etc., and rendering plant food available, a part of which may be lost in the drainage if the water supply is excessive. This downward movement or percolation of water due to gravity is most rapid in soils of small retentive power, that is, coarse-grained open soils. Agencies like lime, which flocculate the soil particles and loosen the soil, promote percolation, and those like alkali salts, which tend to compact the soil and puddle its particles, retard it. When the supply of water ceases evaporation commences, and the soil water begins to rise by capillarity, carrying along with it dissolved plant food which accumulates in the surface soil within easy reach of the roots of plants. A harmful accumulation of soluble salts (alkali), however, is thus sometimes brought about in regions of deficient or irregular rainfall.

The capillary properties of soils are of great importance since they determine largely the available water supply of soils. Different soils vary widely as regards the amount of capillary water they retain. Schübler has shown that the water content of a soil is a function of its structure. Coarse sand sometimes retains as little as 15 per cent, while heavy clay loam and soils containing a large amount of humus often retain as much as 50 to 60 per cent. Ordinary loams retain about 40 per cent. As King has pointed out, however, the amount of capillary water actually found in soils in the field are as a rule smaller than the theoretical amounts that the soils are capable of holding, and are controlled to a large extent by the depth of the water table, which is constantly fluctuating. The capillary movement of water has been observed to extend to a depth of seven feet, but declines as the depth of the water table increases. As a rule the amount of capillary water in the soil decreases from the water table upward toward the surface. In the finer soils the moisture as a rule rises more slowly, but to a greater height than in the coarser. The force, surface tension, which causes water to rise in a soil also produces a lateral movement, but this is much slower than the other. All movements of water become more rapid as the soil approaches saturation.

Under ordinary conditions moisture is constantly escaping from the soil by evaporation. Evaporation may be reduced by tillage and mulching which interfere with the capillary rise of moisture in the soil, and by the use of windbreaks which lessen the drying effect of winds. The belief is common that the moisture conditions of soils may be materially modified by the use of fertilizers, more especially by the application of common salt, but careful observations and experiments on this point have failed to show any decided effect in increasing the water content of soils by ordinary applications of salt and similar substances.

Colloidal substances, in humus, clay and the like, appear to play an important part in soils, influencing especially their absorptive properties. Unfortunately exact knowledge on this point is comparatively limited and not yet sufficient for generalization of much practical significance.

Biological Action in the Soil.— A large and very important part of the changes which go on in soils is due to biological processes, that is, to the actions of living organisms, including the roots of plants, earthworms and other living agencies, but especially the microorganisms, generally grouped under the term bacteria. These play an important part in fixing the free nitrogen of the air in the soil for the use of plants, in converting the organic nitrogen of soils into readily available forms by the process of nitrification, or in causing a loss of the soil nitrogen by denitrification. They are also active agents in the disintegration of rocks and the formation of soils; and in the formation of acids from organic matter in the soil, thus rendering the application of lime or other neutralizing agents necessary. It is the object of good soil management to so control the conditions of moisture, aëration, temperatures, etc., that the beneficial biological processes are promoted and the harmful restrained.

Bacterial life is suspended or may be destroyed in very dry soils. Hence the number of bacteria in soils is low after drought and high after rain. Excessive moisture, however, produces conditions (reduced aëration, acidity, etc.) unfavorable to beneficial organisms but favorable to harmful organisms, such as denitrifying bacteria, which cause loss of nitrogen or its conversion into less assimilable forms, and protozoa and similar organisms, which feed on and hence reduce the number of beneficial organisms. Hence it is very important for bacteriological as well as other reasons that soils should be well drained. Bacterial action is more intense and long-continued in warm soils. Bacteria live but are not active in frozen soils. Like the higher plants they are dormant in winter but awaken with renewed life and activity in the spring. The promptness and vigor with which they awake depends upon and in a measure determines whether a soil is «early» or «late.» About 25° C. is considered the optimum temperature for the growth of the more important soil organisms. Beneficial organisms do not as a rule thrive in acid soils, hence such soils should be limed to correct the acidity. Excessive alkali is also harmful. Soils must be well supplied with organic matter (humus) to furnish the food (energy) required by bacteria, and with a certain amount of phosphate, which is also a necessary food. The activity of soil organisms is influenced not only by soil conditions but also by the character of the plants grown on the soil. For example, nitrification appears to be more active under corn than under timothy and mixed grasses, and similar differences have been noted with other crops.

Among the more active and important classes of soil organisms are *molds* which fix nitrogen, produce ammonia and decompose cellulose; *mycorrhiza,* which probably fix nitrogen; *actinomyces,* which decompose organic matter; *algæ,* which manufacture food for *azotobacter; protozoa,* which prey upon beneficial organisms; *bacteria,* which oxidize carbon, fix and transform nitrogen and make mineral constituents of the soil available. Many organisms which cause plant diseases also live in the soil and play an important part in determining its productiveness. The destruction of these organisms as well as those that interfere with the growth of beneficial bacteria is of great practical importance from the standpoint of soil sanitation and productiveness. So-called «exhausted,» «tired» or «sick» soils are very often simply those in which harmful organisms predominate and their productiveness is readily restored by partial sterilization by means of heat, as in the case of the steaming of greenhouse beds, or by the use of volatile antiseptics like carbon bisulphide, toluol and others.

Soil Toxins.—The theory has been advanced that soils are rendered unproductive by the presence of toxic substances excreted by the roots of plants, produced by bacteria or derived from the decomposition of organic matter. According to Russell «there is no evidence of the presence of soluble toxins in normally aërated soils sufficiently supplied with plant food and with calcium carbonate, but toxins may occur on 'sour' soils badly aërated and lacking in calcium carbonate, or on other exhausted soils. There is no evidence of any plant excretions conferring toxic properties on the soil, but . . . a growing plant may poison its neighbour. . . . Soluble bacterio-toxins are not normal constituents of soils, but must represent unusual conditions wherever they occur. But the possibility of the existence of toxins insoluble in water still remains.» Schreiner in his exhaustive study of the organic matter of the soil has isolated a great variety of compounds some of which have toxic properties.

Exhaustion, Improvement and Reclamation of Soils.— Soils are said to be exhausted when they no longer yield profitable crops, but strictly speaking there is no such thing as absolute exhaustion of soils. However, soils decline in productiveness both as a result of loss of fertilizing constituents from the soil and of deterioration in its physical and biological condition.

Among the principal causes of loss of soil fertility are (1) the growth and removal of crops without restoring the equivalent of the fertilizing constituents they contain; (2) surface washing, and (3) leaching. All crops contain a considerable amount of fertilizing matter drawn from the soil, and it is held that if these crops are grown continuously and sold away from the farm without return of an equivalent in manure or fertilizers the soil will in time show a decline in fertility. The harmful effects of surface washing is a matter of common observation and needs no further discussion here. The loss of fertility in the drainage water is generally supposed to be very considerable, and under certain circumstances this is true, depending upon the character of the soil and the treatment to which it is subjected and the fertilizers applied. «Leachy» soils part very quickly with the fertilizing materials applied to them unless covered with crops which utilize the fertilizers promptly, and, as already shown, certain fertilizers have a tendency to set some of the soil constituents free and throw them into the drainage water.

While these are all possible sources of loss, it is probably safe to say that under ordinary conditions the chances of loss of any considerable amount of lime, potash or phosphoric acid in the drainage water of soils are very small. As regards the loss of the important and expensive fertilizing constituent, nitrogen, however, the case is very different. The soil appears to have very little affinity for one of the forms of this element most commonly used as a fertilizer, namely, nitrate of soda, and if it is not quickly taken up by the crop it is likely to pass into the drainage and be lost. Moreover, other less soluble forms of nitrogen are under favorable conditions rapidly converted into nitrates by the process of nitrification, and so may also be lost in the drainage. Dehérain has reported experiments in which the loss of nitric nitrogen in the drainage from a bare soil in the course of a year was nearly 180 pounds per acre, while the loss from a soil which was kept covered by a crop was almost insignificant, although fully as large an amount of nitrates was formed in the latter case as in the former. Under unfavorable soil conditions there may be considerable loss of nitrogen through denitrification.

Unproductiveness due to physical condition may be corrected by a variety of means, including drainage, irrigation, tillage and by a judicious system of cropping and the proper use of manures and fertilizers.

There are large areas of swamp, marsh or muck soils which prove highly productive when reclaimed. In reclaiming such soils the first essential is thorough drainage. This is not only necessary for the purpose of removing the excess of water, but to allow the free circulation of air in the soil, in order that the poisonous compounds which are usually present may be oxidized and thus rendered harmless, and that the processes of decomposition and nitrification so necessary to render plant food available in this class of soil may be set up. Paring and burning to a depth of 12 to 16 inches as practised in Ireland and in European countries, and the liberal use of manures and fertilizers may often be necessary in addition to drainage, since such soils are as a rule deficient in phosphoric acid and potash, and although composed almost entirely of organic matter they are often deficient in available nitrogen. Lime and the bulky manures often exert a beneficial effect on the texture of the soils, rendering them more porous, and thus improving drainage and increasing aëration and nitrification. Liberal applications of wood ashes also improve the texture of the soil, correct acidity and favor nitrification, and at the same time furnish potash and phosphoric acid. An application of a mixture of kainit or muriate of potash with some cheap phosphate, such as fine-ground Florida phosphate, may be substituted for the ashes. The untreated mineral phosphates have been used with advantage on muck soils, the decomposing organic matter assisting in rendering the phosphoric acid available.

There are large areas of sandy lands in different parts of the United States which are extremely deficient in plant food, but which prove very valuable for a variety of purposes, but especially for early crops, when they are properly managed. One of the first requirements of such soils is an increase of humus to improve their water-holding capacity. The most effective means which has been found for increasing the humus supply in such soils is the growing and turning under of green crops, preferably leguminous plants, which are nitrogen collectors. Moderate liming has also been found beneficial in many cases.

Methods of Investigation.— Three principal methods are employed in studying the characteristics and requirements of soils, namely, (1) mechanical and chemical analysis; (2) experiments in lysimeters, pits, pots or boxes, and (3) field experiments. The nature of the methods pursued in the chemical investigation of soils has already been indicated. The object of mechanical analysis is to separate the soil into particles of different degrees of fineness so that a basis may be secured for judging of the physical properties of the soil. Mechanical analysis as ordinarily practised separates a soil into what is termed skeleton (consisting of coarse particles like gravel and coarse sand larger than 0.5 millimeter in size) and fine earth, which includes all particles passing a sieve with meshes 0.5 millimeter in diameter. The fine earth is further separated into some six different grades, ranging from medium sand with particles 0.25 to 0.5 millimeter in diameter, through fine sand, silt, to clay, the particles of which are less than 0.005 millimeter in diameter. The methods of mechanical analysis which have been employed are of three classes: (1) hydraulic (Hilgard, Schöne, Nöbel); (2) sedimentation (Osborne, Schloesing, Knop), and (3) centrifugal. The methods which have been most commonly used in the United States are modifications either of Osborne's beaker (sedimentation) method or Hilgard's elutriator (hydraulic) method. The physical examination of a soil also involves determinations of water-holding capacity, rate of percolation, capillary rise, hygroscopicity, adhesive power, etc., for all of which ingenious methods have been devised.

Soil Surveys.— The soils of the United States have been studied to a considerable extent by the agricultural experiment stations, but while the work of the stations on soils has been quite varied and extensive it has not been systematic. The need for systematic and concerted study of soils has, however, been met by the organization and development of the work of the Bureau of Soils of the United States Department of Agriculture, which undertakes the survey, mapping and study of soils on a scale never before attempted. In the inauguration of this work «it was recognized that differences of commercial value could be seen in the field from the character of the soil and from its relation to crops and vegetation; that it was quite possible to map these soil areas independently of the geology of the area or the exact chemical or physical character of the soil; that the proper course was to construct maps in the field, showing the area and distribution of the soil types; to explain as fully as possible from geological considerations the origin of the soil, and to have the soil chemist and physicist study the differences in the soil types.» Note is also made of climatic and economic conditions which may significantly affect the cropping practice. Extensive laboratory investigations supplemental to the field operations are conducted with a view to determining the chemical and physical properties of soils, improving methods and working out a more clearly defined classification.

In Germany elaborate soil surveys with reference to physical and chemical properties and productive and taxable value of the land have been made under government auspices by the «Laboratorium für Bodenkunde» at Berlin. A systematic chemical survey of the soils of Belgium was undertaken under the direction of the Gembloux Station. In France soil surveys have been undertaken by several of the departments, the soils being mapped with reference to their crop adaptations and fertilizer requirements. In Russia soil surveys have been successfully prosecuted in several of the governments, and Japan has made considerable progress in work of this character.

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SOIL, Physical Properties of. See Soil.

SOIL SURVEY. See Soil.

SOILING, the system of feeding grazing animals, especially cattle, in barns and other enclosures, with freshly cut green crops grown for the purpose, instead of turning them out to pasture. The practice has its most important application in intensive farming and on small farms as in Europe, but is also practised in other regions where the agricultural resources are undergoing development from extensive to intensive methods. In many parts of Europe the animals are soiled during the whole year, never being allowed to graze at all. In the older parts of America and Australia this is also true to some extent; but generally in these newer countries the practice is combined with pasturing, the animals being usually kept in the barns during the day to reduce annoyance from flies, and turned out to graze at night fall. It is also true in America that the animals are more seldom fed in barns even during summer than in Europe. However, dairy cattle, especially in the vicinity of cities, are frequently kept in the stables and fed there the year around with soiling crops, supplemented with hay, grain and other dry feeds. This practice appears to be growing in popularity.

In America soiling first began to attract attention about 100 years ago, though not until the middle of the past century did it begin to gain ground rapidly, due mainly to the growth of population and the consequent increase in the values of land, more especially in the northeastern quarter of the United States and adjacent Canada. Agricultural literature shows that at that time the plants most favored were the taller growing fodder crops such as timothy, red clover, oats, cabbage and various roots, especially mangels, turnips and carrots. While all these are more or less popular at the present time millet, rape, sorghum, Kaffin corn, crimson clover, cow peas, soy beans, and alfalfa and combinations of Canada field peas with oats, or barley, and winter vetch with rye have more than supplemented, well nigh supplanted, them in general favor. This is mainly because these crops cover the whole season more completely than the former list and also yield larger quantities of fodder on given areas. Especially is this the case with alfalfa which not only may be cut several times, thus yielding heavily, but the green material is notably rich in muscle and milk-forming compounds.

In the Middle West where areas are less restricted than in the East and where natural grasses are abundant, pasturing rather than soiling is the vogue. But even here the newer practice is gaining headway in the vicinity of cities because of its economy and expediency. There as elsewhere a larger number of animals may be sustained by an equal area in pasturage. When the animals are confined the expense of erecting and maintaining fences is eliminated, except for small paddocks. The waste of food due to trampling and defiling with manure is avoided. The animals may always be assured of abundant food. The manure may be evenly distributed, especially when mechanical spreaders are used, thus preventing the too abundant deposits in some parts of the field, the almost entire lack in others and the irregular distribution between these two extremes. Except for the increased labor of handling the food and the manure the system has no serious disadvantage, though it is claimed that animals thrive best where they are allowed exercise; but this may be secured in summer at least by the freedom of a paddock, preferably at night. For this last reason soiling and pasturing are commonly combined in the United States, the pasture being kept as remote as convenient from the crop fields so the animals may not become restive and be tempted to break through the fences.

Experiments have been tried in soiling and bulletins published by various experiment stations, more especially those of the East. The Bureau of Animal Industry of the United States Department of Agriculture has also issued information on this subject.

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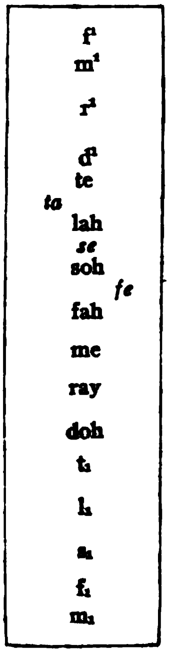
SOISSONS, swä-sôṅ, France, a city in the department of Aisne, 51 miles northeast of Paris on the Aisne River. It is an episcopal see and the old cathedral (12th century) contains a library, with a valuable collection of manuscripts. Here stands the venerable abbey of Saint Jean des Vignes (1076), where Thomas à Becket sought refuge when exiled; the Romanesque church, Saint Peter (12th century); Notre Dame and Saint Léger. The chief secular buildings are a museum of antiquities and a public library, with 30,000 volumes; besides a college and two seminaries and a hospital. There are interesting Roman antiquities, including the ruins of a large amphitheatre, coins, mosaics, sculptures and vases. Near the suburb of Saint Vaast lies the village of Saint Médard, the site of a revered abbey with seven churches, a famous place of pilgrimage. Soissons has oil-mills, stocking factories and tanneries and a large trade in grain, flour and beans. The town has been the scene of many important historical events, the battle ground of fierce armies and was largely devastated in the great World War. See War, European.

SOJOURNER TRUTH, American abolitionist: b. Ulster County, N. Y., about 1775; d. Battle Creek, Mich., 26 Nov. 1883. She was born a slave and received the name of Isabella Hardenberg. That of Sojourner Truth she claimed to have been revealed to her by God as designating her mission in the world. By the act of the New York legislature of 1827 abolishing slavery in that State she became free and, having gone to New York, was brought to the attention of Susan B. Anthony and other well-known abolitionists and reformers. Encouraged by them, she began her career as a public lecturer, at first upon the slave question and, after the emancipation of her people, as an advocate of women's rights and in the cause of temperance. For many years she endeavored to secure from the government of the United States a grant of public lands for the establishment of a negro colony.

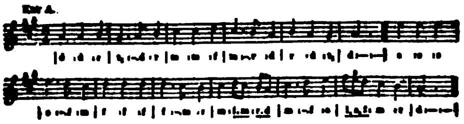
SOKOLOW, Nahum, Russian Hebrew journalist: b. Wishograd, government of Plock, Russian Poland, 10 Jan. 1859. He early displayed remarkable intellectual gifts and in 1884 after receiving a careful education he became assistant editor of *Ha-Zefirah* at Warsaw. The publication was later changed to a daily and he became editor and manager. After the death of the owner, Slonimski, in 1904, he was owner as well as editor. He was a prolific writer for the Hebrew press and after 1896 was also editor of the Polish weekly *Israelita*. He is generally regarded as the foremost Hebrew journalist in Russia. He founded the yearbook 'Ha-Asif' and its successor, 'Sefer ha-Shanah' (1899–1902). After long hesitation he joined the Jewish Nationalist movement. During the European War he made his home temporarily in London. Author of numerous works, among which may be mentioned 'Le-Maranan we-Rabanan' (1900); 'Tochen ha-Ziyonat' (1912), etc. In 1919 he was engaged in completing his only work in English, 'History of Zionism' (2 vols.), of which one volume has been published.

SOKOTO, sō-kō'tō, Nigeria, Central Africa, (1) the former a capital of the government of the same name, situated on a long ridge, 18 miles east of Warnu, which forms a joint capital. It is surrounded by a wall and is well built in Moorish style. There were at one time important manufactures of muslin, shoes, ironwork, etc., and a population of 80,000, but this has now dwindled to 1,500. (2) A semi-dependent native government, bounded by Sudan on the north, the river Benue on the south and on the east and west by the native kingdoms of Bornu and Gandu, respectively. Its area is about 100,000 square miles. The general relief is flat, but in the province of Adamawa rises to an altitude of 10,000 feet. It is well watered and there are large deposits of excellent iron ore. The ruling race is the Fulah. Their subjects — the Haussa and various negro tribes — form the population. In 1885 the sultan of Sokoto put his kingdom under the protectorate of Great Britain and granted to the Royal Niger Company the monopoly of trade. In 1902 the British assumed control, and suppressed a rebellion. The principal town is now Kano.



Modulator.

SOL-FA, TONIC SOL-FA, or MOVABLE DOH, SYSTEM, a modern scientific method of classifying, explaining and teaching the facts of music, of especial value in the acquisition of the art of sight-singing. The system proceeds on the principle of giving the chief prominence to the fact that there is in reality but one scale in music, which is raised or lowered according to the pitch of the key. The seven notes of the diatonic scale are represented by the solfeggio (q.v.) syllables, or rather modifications of them — DOH, RAY, ME, FAH, SOH, LAH, TE; DOH standing for the keynote in whatever key the music is written. In the early exercises the pupils are accustomed to a scale or diagram, called the Modulator, representing pictorially the exact intervals of a key, with the semitones in their proper places. In written music only the initial letters of the solfeggio syllables are used — d, r, m, f, s, l, t; the higher octaves of a given note being distinguished by a ^{1} above, as d^1, r^1; and the lower by a $_1$ or $_2$ below, m_1, m_2. The name of the key is prefixed to a tune as its signature, as "Key A," "Key B flat" — the keynote being, in all the major keys, DOH. To indicate rhythm a perpendicular line | precedes the stronger or louder accent, a colon: the softer accent and, where necessary, a shorter perpendicular line | the accent of medium force. A note immediately following an accent mark is supposed to occupy the time from that accent to the next. A horizontal line indicates the continuance of the previous note through another pulse or beat. A dot divides a pulse into equal subdivisions. A dot after a mark of continuance indicates that previous note is to be continued through half that pulse. A comma indicates that the note preceding it fills a quarter of the time from one accent to the next; a dot and comma together three-quarters. An inverted comma ' is used to denote that the note preceding it fills one-third of the time from one accent to the next. An unfilled space indicates a rest or pause of the voice. A line below two or more notes signifies that they are to be sung to the same syllable. The following example of the tonic sol-fa shown alongside of the ordinary notation, illustrates most of the features named.



My Country, 'Tis of Thee.

In modulating into a new key the note through which the transition is taken is indicated by a combination of the syllabic name which it has in the old key with that which it has in the new — me lah, for example, being conjoined into m'lah, and in writing this note (termed a bridge note) the initial letter of its syllable, as a member of the old key, is placed in small size before and above the initial of the syllable of the new, as ^{m}l ^{d}s. In the case, however, of an accidental, where the transition is but momentary, a sharpened note changes its syllabic vowel into e, and a flattened note into aw, spelled a, as fah, fe, soh, se, te, ta. In the minor mode lah is the keynote; the sharp sixth is called bay and the sharp seventh se. The signature of the key of A minor is "Key C"; lah is A.

The method of teaching is of equal importance with the notation itself. For a full explanation of this system, consult Curwen, 'Course of Lessons and Exercises in Tonic Sol-fa.' Its advocates maintain that it possesses advantages over the common system in the facility of its acquisition; the distinctness with which it indicates the keynote and the position of the semitones; the cheapness with which it is printed; and the manner in which, they say, it explains the proper mental effects of notes in harmony and key-relationship and employs them in teaching. It has, however, been objected to by others, from its withdrawal of the direct indication of both absolute and relative pitch to the eye which exists in the common notation, from its limited applicability to instrumental music and from its acquirement not being, like that of the ordinary notation, an introduction to the world of musical literature. It presents, however, no barrier, but rather a road to the acquisition of the older notation; and its widespread use and the testimony of the general body of practical teachers are eloquent arguments in its favor.

In the history of music various attempts have been made to introduce a musical notation in which the staff with its lines and spaces is dispensed with. Jean Jacques Rousseau suggested, but afterward discarded, a notation where the notes of the scale were indicated by the Arabic numerals — a principle which is the chief feature of the Chevé system, largely used in France, the time-names of which have been adopted by the Tonic Sol-fa system. The latter system, similar to Rousseau's in its leading features, has been promoted chiefly by the Rev. John Curwen (q.v.), who obtained his main principles about 1840 from Miss Glover, a teacher at Norwich. It was brought into almost general use in the singing schools of Great Britain and her colonies and later into the United States with moderate success. The London Tonic Sol-fa College was founded in 1869.

SOLAN GOOSE, the common gannet (q.v.).

SOLANACEÆ, the nightshade family, an order of plants containing about 1,500 species arranged in 70 genera, mostly herbs and shrubs widely distributed in warm climates, and especially in tropical America. They are usually malodorous and are characterized by alternate, lobed or undivided leaves, monopetalous flowers of various colors and sizes arranged in various ways — fascicles, cymes, solitary and followed by two- to many-celled fruits with numerous seeds. The order is of wide economic importance, since it contains several leading food-plants, such as the potato, tomato, tobacco, cayenne, red or garden pepper and various weeds and garden plants, as the petunia, jimson-weed, mandrake and others. The typical and foremost genus is *Solanum*, of which more than 500 species have been described, mostly natives of tropical America. They are smooth, downy or spiny plants with white or blue axillary flowers borne singly, in cymes, or in fascicles, followed by roundish two-celled berries containing many kidney-shaped seeds. The principal species is *S. tuberosum*, the common potato (q.v.), in which, as in many other members, is found an alkaloid, solanin, reputed to produce unpleasant physiological effects when the plants are eaten to excess. *S. melongena*, the egg-plant, is another leading food-species. It was formely regarded as noxious; on which account Girarde (1597) entreats his countrymen to eschew it. *S. aviculare* or *laciniatum* is the kangaroo apple of Australia and New Zealand, where its fruits are eaten. *S. muricantum*, the pepino, melon-pear or melon-shrub, yields an edible fruit suggesting an acid-flavored egg-plant fruit. It is grown to a small extent in the United States. The fruits of several East Indian species are eaten either alone or in curries, etc. Two European species, *S. nigrum*, the common nightshade, and *S. dulcamara*, the bitter-sweet, are common weeds in the United States. The horse nettle (*S. carolinense*) and *S. rostratum* are native, spiny weeds. Several species were formerly used in medicine and still are in the Orient. *S. saponaceum* yields berries which are used as a substitute for soap. Several species, particularly *S. jasminoides*, the potato vine, and *S. seaforthianum*, are popular greenhouse plants of easy culture.

SOLANINE ($C_{21}H_{35}NO_7$), a substance obtained from the *Solanum mammosum* of the Antilles. It is also found in the berries of the *S. nigrum*, as well as in the leaves and stems of bittersweet (*S. dulcamara*). To obtain it ammonia is poured into the filtered juice of the berries, when a grayish matter falls down, which is collected on a filter, washed and treated with boiling alcohol. The solanine precipitates from this by evaporation. It is an opaque, white, somewhat pearly-looking powder; without smell; very bitter; fusible below 100° C.; decomposable at a higher temperature; insoluble in water, ether, oil of olives and essence of turpentine; but very soluble in hot alcohol, from which it crystallizes in slender, silky needles. It combines with acids, forming salts. It is eminently emetic, and even in small doses is poisonous.

SOLAR CORONA, *in astronomy*, the portion of the aureola observed during total eclipses of the sun, which lies outside the region of colored prominences. The region of colored prominences is called the chromosphere. See SUN.

SOLAR CYCLE. See CHRONOLOGY.

SOLAR ENGINE. See SOLAR MOTOR.

SOLAR MICROSCOPE, an instrument by means of which a magnified image of a small transparent object is projected on a screen, the light employed being sunlight. The solar microscope is really a magic lantern, in which the microscopic object is affixed to a clear plate, and the light employed bright sunlight reflected into the instrument. The reflector being adjusted throws the sun's rays into a tube set in a window shutter, closed to exclude the light. A double lens focuses the image on a second system of lenses, which throw it upon the screen. See MICROSCOPE, SOLAR.

SOLAR MOTOR, a mechanism for securing motive power from the sun. For many years the attention of inventors has been directed to the question of utilizing the direct rays of the sun as a substitute for coal, wood or other fuel; large burning-glasses or reflectors being the general form of the various machines. A so-called «burning mirror,» made in France by Villette, was four feet in diameter, and produced so intense a heat that, according to the report, it melted cast iron in 16 seconds, probably an exaggeration. It was for a long time difficult to build a concave mirror of very large size, but this was finally overcome by having the surface of the concave mirror covered with small pieces of glass, or mirrors, each of which is so placed that the light or reflection from each side is thrown upon the same spot, the sum total, or the amount of heat centralized, being equivalent to the amount reflected by each glass, mutiplied by the number of mirrors. In Europe the early solar glasses were generally of two kinds; that is, the heat was concentrated in two ways — by reflection from polished concave mirrors and by refraction through a convex lens. The earliest use, centuries ago, of such a contrivance was theoretically to dazzle or blind an enemy, metal discs being employed; but nearly all such devices failed to be of any practical value. Sir William Herschel experimented with the sun's heat in Africa; and Captain Ericsson made a number of studies in this direction and exhibited a solar motor in New York in 1884.

Within recent years a successful sun motor has been built at South Pasadena, Cal., and here is an automatic engine run by the heat of the sun. In appearance the motor resembles a huge dish of glass, with a central aperture, and at a distance might be taken for a windmill; but the dish is a reflector 33 feet in diameter. The inner surface is made up of 1,788 small mirrors, arranged so that they concentrate the sun upon the central or focal point. Here is suspended the boiler, which is of tubular form and 13 feet long, holding 100 gallons of water, leaving eight cubic feet for steam. The motor is attractive in appearance; built lightly, supported by seeming delicate shafts, though in reality strong enough to resist a wind pressure of 100 miles an hour. The reflector must face the sun exactly, and as heavy as it is, weighing tons, it can be easily moved. It stands, after the fashion of the telescope, upon an equatorial mounting, the axis being north and south; the reflector follows the sun, regulated by a clock, the work being automatic, as, in fact, is everything about it. The true focus is shown by an indicator, and in about an hour after it is adjusted in bright sunlight the steam gauge will register 150 pounds. The steam is carried from the suspended boiler to the engine in a flexible tube and returns again from the condenser to the boiler in the form of water, so that the boiler is kept automatically full. The engine is oiled automatically, and when the dish is once turned, facing the sun, it runs all day as independent of an engineer as does a windmill, developing about 12 horse power. While the motor is most interesting to engineers, it has not demonstrated the practicability of the system in competition with the ordinary steam engine or electric power brought from a distance.

SOLAR PARALLAX. See PARALLAX.

SOLAR STAR. See STARS.

SOLAR SYSTEM, that collection of bodies of which the earth on which we dwell is one, and which are distinguished from all other bodies in the universe by having the sun as the centre of their motions. The bodies of this system may be classified as follows:

1. **The Sun.**— The great central body, shedding its light and heat on all the other bodies and by its powerful attraction, keeping them in their several orbits. It is the fountain-head of all life on the earth. It is about 750 times as massive as all the other bodies of the system put together; hence its attractive power on all these bodies. For a full description of this great luminary, see SUN.

2. **The Planets.**—Bodies which revolve round the sun in elliptic orbits, generally differing little from circles. The planets are opaque and are, therefore, visible to us only by reflecting the light of the sun. They are divided into two classes, *major* and *minor planets.*

The major planets are eight in number; their names, distances and many other particulars respecting them will be found in the table appended to this article. It will be seen that the most distant, Neptune, is more than 70 times as far from the sun as the nearest, Mercury. An idea of the arrangement of the planets will be gathered from the accompanying plate.

It will be noticed by the plate that there is a gap between the orbits of Mars and Jupiter. This is filled by the second class of planets, called *minor planets* or *asteroids.* These bodies are much smaller than the major planets and generally revolve in more eccentric orbits. It is impossible to say exactly how numerous they may be; more than 800 are now known, new ones constantly being discovered, and there may be hundreds, or even thousands, so small that they have not been discovered, and may never be separately recognized. See ASTEROIDS.

3. **The Satellites of the Planets.**— All the major planets, with the exception of the two inner ones, have one or more smaller bodies revolving round them and accompanying them in their courses round the sun. In this respect each of the planets having satellites may be said to form a solar system in miniature, since the motion of the satellites round the planet is quite similar to that of the latter round the sun. The number of satellites is as follows:

	Satellites
The Earth	1
Mars	2
Jupiter	9
Saturn	10
Uranus	4
Neptune	1

There are, therefore, 27 satellites now known. The system formed by a planet and its satellites is designated by the name of the planet. Thus we have the Martian System, the Jovian System, the Saturnian System, etc.

4. **Comets.**— Comets generally revolve in orbits so eccentric that, during the greater part of their course, they are entirely invisible, even to telescopic vision. A few are known to revolve within the orbit of Jupiter, and all that we can observe must have their perihelion not more than two or three times as far as the earth's orbit — otherwise they would be forever invisible. Their times of revolution vary all the way from three years to unknown thousands of years. Those having long periods go far beyond the orbit of Neptune during their course. No limit can be set to their number. Kepler's remark that the heavens may be as full of comets as the sea of fish, though probably an exaggeration, is well fitted to give an idea of the possible number of these bodies. It is certain that only an insignificant fraction of the total number has ever been seen by human eye. See COMETS.

5. **Meteorites or Meteors,** which must be countless millions of millions in number, are so minute that we never see them individually except when they strike our atmosphere and form a shooting star. (See SHOOTING STARS). They may be classed with comets, because the latter are probably of meteoric constitution; perhaps made up of meteors.

6. **The Zodiacal Light,** which is a great lens-shaped cloud of small particles surrounding the sun and extending nearly to the orbit of the planet Mars. This cloud is thickest at the sun, but has a region of reversed curvature within the orbit of Mercury. Its form may be quite closely represented by two ellipsoids of revolution, having the centre of the sun for their common centre, the eccentricity of the inner being about 0.25, and the outer having the form of a thin, ellipsoidal sheet, within which the innermost planets are immersed.

A remarkable feature of the solar system is the clear separation of the eight major planets into two groups, equal in numbers, each comprising four planets with distinctive characteristics. The inner four, of which our earth is one, are dense and highly compressed solid bodies. The four planets of the outer group are many times more massive than the inner ones, the least massive of all, Uranus, being seven or eight times as weighty as the four inner ones put together. As compared with the inner group, the planets of the outer group are also distinguished by being larger in a yet greater proportion than they are massive. Any one of the inner group would be a small object alongside the smallest of the outer group. A similarity of constitution also seems to mark the outer planets; it is highly probable that all are surrounded by dense atmospheres — in fact, that each consists of a comparatively small nucleus surrounded by a gaseous envelope with clouds floating in it as they do in our atmosphere.

Possible Unknown Planets.—The excessive motion of the perihelion of Mercury, as well as smaller, but well-defined motions in the node of Venus and the perihelion of Mars, none of which could be accounted for by the disturbances caused by the attractions of the known bodies of the solar system, long ago led to the suspicion that there might be one, or even a ring of, undiscovered planets revolving about the sun within the orbit of Mercury. Should such planets exist they ought, from time to time, to pass between us and the sun, so as to be visible on the disc of the latter. Several observers, studying the sun, have supposed that they saw such objects. But there is no doubt that they were mistaken. For 20 years past the sun has been photographed almost every day, as well as constantly scanned by the telescope, in Europe and in America. No photograph has ever shown, and no really experienced observer has ever seen anything of the sort. Another way of detecting such bodies would be by scanning the neighborhood of the sun during total eclipses. This has been done at almost every such eclipse, during the last 30 years. Moreover, in recent times, photography has been called to the aid of the search, especially by the Lick Observatory, in California. In one of the attempts, stars were photographed down to nearly the eighth magnitude; but nothing was ever found except known stars. We may, therefore, regard the non-existence of any visible planet between Mercury and the sun as well proved.

In addition to this, the most interesting discovery was made by Seeliger in 1906 that the outstanding discrepancies in the motions of the planets can be fully accounted for by the disturbing pull of the zodiacal light, provided that we ascribe to this only an almost inconceivable tenuity. It is sufficient to assume that the densest portion has but 2.52 by 10^{-11} times the density of the sun in order that its mass may be great enough to produce the disturbances observed. Moreover, it is found that on this assumption no new disturbances are introduced into the perturbations of any of the planetary elements of a size great enough to be evident to observation.

The question whether there may be a planet beyond Neptune is not so easily settled. The probable existence of such a body has been inferred on three grounds: (1) Outstanding discrepancies in the computed motion of Uranus; (2) the existence of certain comets, the aphelia of whose orbits lie outside the orbit of Neptune; and (3) the inference, based on the planetesimal theory of the development of the solar system, that the orbit of the outermost planet will not be a nearly circular one. Of these, the first furnishes the most reliable evidence and it alone can serve as a basis for predicting the planet's position and so leading to its discovery, if, indeed, it has an existence. In the course of a century, accurate observations of Uranus will have accumulated throughout the entire circuit of its orbit, and by this time also the motion of Neptune will have been sufficient to indicate the position of the planet. As yet, however, an accurate indication is not possible, and careful search for the body has met with no success. It is inferred that it is from the 12th to the 13th magnitude, with an apparent diameter of perhaps 1″; as it is so far distant from the sun, its motion among the stars is certainly very slow, and all of the circumstances contribute to render its discovery extremely difficult.

The planets are all so distant from us that, to the naked eye, they appear like stars. For the most part the five nearest to us would be classed among the brightest of the stars, Venus and Jupiter being generally brighter than any fixed star. They are also distinguished from the stars by their apparent motions, which may be seen by watching them from night to night. Their apparent situations relatively to the sun are called *aspects*. The latter are different according to whether the orbit of the planet is inside or outside that of the earth; that is, whether it is an inferior or superior one. A glance at the arrangement of the system will show that the inferior planets, Mercury and Venus, can never be seen in the opposite direction from the sun, but only seem to swing back and forth on each side of the sun as they perform their revolutions around this luminary. Their apparent distance east or west from the sun at any time is called their elongation. At the greatest elongation, Venus is about 45 degrees from the sun, and Mercury at different distances, generally ranging between 20 and 30 degrees, according to its position in its very eccentric orbit. But the superior planets seem to course relatively to the sun all the way round the sky in performing their revolution. When in the opposite direction from the sun they are said to be in *opposition*. This is the most favorable time for observing them, because they are then nearest to the earth, and their visible hemisphere is fully illuminated. They then rise about the time of sunset, and cross the meridian about midnight.

The inferior planets pass by the sun during their apparent swinging from one side to the other. When they pass on our side of the sun they are said to be in *inferior conjunction;* when beyond the sun, in *superior conjunction.* These conjunctions take place at fairly regular intervals. The best time to see an inferior planet is in the evening, some time before inferior conjunction; or in the early morning twilight, some time after it.

The plate shows the most important relations existing among the elements of the planets. The elements of the planets are given in the following tables:

PLANET	Distance from the Sun			Distance from the Earth		Time of revolution round the Sun	Synodic revolution
	Mean	Greatest	Least	Greatest	Least		
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Mean solar days*	*Mean solar Days*
Mercury	36,000,000	43,400,000	28,600,000	134,800,000	50,900,000	87.9693	115.887
Venus	67,200,000	67,700,000	66,700,000	161,200,000	24,500,000	224.7008	583.920
The Earth	92,900,000	94,500,000	91,300,000	....	....	365.2564	....
Mars	141,500,000	154,700,000	128,300,000	248,600,000	34,500,000	686.7505	779.936
Jupiter	483,300,000	506,600,000	460,000,000	599,500,000	367,200,000	4332.5800	398.884
Saturn	886,100,000	935,800,000	836,400,000	1,027,200,000	745,100,000	10759.21	378.093
Uranus	1,782,000,000	1,864,500,000	1,699,600,000	1,956,900,000	1,607,300,000	30686.82	369,656
Neptune	2,791,600,000	2,817,000,000	2,767,000,000	2,909,100,000	2,675,000,000	60181.11	367.486

PLANET	Time of rotation on axis			Inclination of the planet's equator to its orbit		Diameter	Volume, Earth's = 1	Mass, Earth's = 1	Density Earth's = 1	Force of gravity, Earth's = 1	Bodies fall in second	Apparent diameter as seen from the Earth	
												Greatest	Least
	H.	*M.*	*S.*	*Deg.*	*Min.*	*Miles*					*Feet*	*Sec.*	*Sec.*
Mercury		?			?	3,030	0.056	0.061	1,173	0.439	7.06	12.9	4.6
Venus		?			?	7,700	0.92	0.82	0.89	0.802	12.90	65.2,	9.5
The Earth	23	56	4	23	27	7,918	1.000	1.000	1.000	1.000	16.08	......	....
Mars	24	37	23	24	00	4,230	0.152	0.105	0.711	0.376	6.05	24.5	3.6
Jupiter	9	55	37	3	5	86,500	1309.00	317.7	0.242	2.65	42.66	50.0	32.0
Saturn	10	14	24	26	49	73,000	760.00	94.8	0.128	1.18	18.99	20.0	14.0
Uranus		?			?	32,000	69.237	13.518	0.195	0.754	12.12	4.1	3.8
Neptune		?			?	35,000	84.955	16.469	0.300	1.142	18.36	2.9	2.7

SIMON NEWCOMB.

SOLAR TIME. See DIAL; SUN.

SOLARIO, sō-lä'rē-ō, **Andrea da,** Italian painter: b. about 1460; d. 1515. He lived in Venice (1490–93) with a brother, Cristoforo, who was an architect and sculptor. His work was modeled after Leonardo da Vinci, and in 1507 he was called to Normandy to execute work offered Da Vinci. His best known works are 'Ecce Homo'; 'Repose in Egypt' (1515); 'Crucifixion' (1503); a 'Madonna' and 'John the Baptist.'

SOLARIO, Antonio, Italian painter: b. at Civitá, about 1380; d. 1455. He studied in Bologna, Venice, Florence and Rome, but practised his art mainly in Naples. His chief work consists of 20 large frescoes in the monastery of Saint Severino. His backgrounds are said to have been superior to his figures.

SOLBERG, Thorvald, American writer: b. Manitowoc, Wis., 22 April 1852. As a member of the staff of the Library of Congress in 1876–89 he became interested in the question of international copyright and was a delegate to the several European congresses. His most notable works are 'International Copyright in the Congress of the United States' (1886), and 'The Copyright Law in Force in the United States in 1900' (1900).

SOLDANELLA, *in botany,* a genus of plants of the order *Primulaceæ.* They are small herbs, inhabiting the alpine districts of southern Europe, corola sub-campanulate, of one cleft and fringed on the margin. *Soldanella alpina* having blue flowers, frequenting the hills of Switzerland, is an object of extensive culture in England.

SOLDER, sŏd'er, a fusible alloy of metals employed to join or unite metals. The principle involved is that the molten alloy applied shall partly fuse the metal surfaces, thus creating a metallic union. As a rule, the solder should be easier of fusion than the metal to which it is applied. The solder should also be of or near the same color as the metal. For fine steel, copper and brass work gold or silver may be employed. But, broadly speaking, iron is soldered with copper, and copper and brass with tin. The most usual solders are the compound, which are distinguished into two principal classes, hard and soft. Any solder that requires a red heat for melting is termed a hard solder; these are ductile, will bear hammering and are commonly prepared of the same metal as that which is to be soldered, with the addition of some other, by which a greater degree of fusibility is obtained, though the addition is not always required to be itself easier of fusion. Under this head comes the hard solder for gold, which is prepared from gold and silver, or gold and copper, or gold, silver and copper. The hard solder for silver is prepared from equal parts of silver and brass, but is made better for fusion by the admixture of 1-16 of zinc. The hard solder for brass is obtained from brass mixed with a sixth or an eighth, or even one-half of zinc, which may also be used for the hard solder of copper. The soft solders, melting below a red heat, are much used in plumbing and tinning; they melt easily, but are usually brittle and, therefore, cannot be hammered. Tin and lead in equal parts make a good soft solder. Of easier fusion is that consisting of bismuth, tin and lead in equal parts. In the operation of soldering, the surfaces of the metal to be joined must be made very clean and applied to each other. It is usual to secure them by a ligature of wire or other device. The solder is laid upon the joint, together with sal-ammoniac and borax or common glass, according to the degrees of heat intended. These additions defend the metal from oxidation. Glaziers use resin, and pitch is sometimes employed. Tin-foil, applied between the joints of fine brass work, first moistened with a strong solution of sal-ammoniac, makes an excellent juncture, care being taken to avoid too much heat. It was at first found very difficult to solder aluminum, but a satisfactory solder was found in an alloy of gold, silver and copper, to which some add a little zinc. Soft solder is applied with a soldering iron, or in some cases with a machine as in closing fruit cans. The regular soldering iron has a pointed copper head and a wooden handle. In use the copper head is heated almost to redness and having been carefully cleaned and scraped, it is used to pick up some of the molten solder and apply it to the work. The surface or edges to be soldered must be quite clean and bright and the process is assisted by a flux, as of resin or chloride of zinc. Hard solder is essential for joining steel, iron gun metal, brass, etc., and permits a much stronger joint than soft solder. The process of applying hard solder is often called brazing, from the similarity of the alloy used to brass. Common mixtures are copper 60 and zinc 40, for soldering iron; copper 40 and zinc 60, for copper and hard brass; silver 30, copper 50 and zinc 20, for soldering silver, brass, gold and some irons. See ALLOYS; WELDING.

SOLDIERS OF FORTUNE. See MERCENARIES.

SOLDIER BEETLE, the name given to the beetle of the tribe *Telephoridi,* family *Malacodermidæ.* The larvæ generally feed upon plant-lice, catterpillars or other soft-bodied insects. The most common species in the eastern part of the United States is the *Chauliognathus pennsylvanicus,* a native of Pennsylvania, which are specially valuable as cross-fertilizers of plants.

SOLDIERS' HOMES, the general name of various institutions in the United States, under national or State control, for the care of sick and disabled soldiers and sailors. These homes were the direct outcome of the Civil War. The Federal institution is known as the National Home for Disabled Volunteer Soldiers and has branches at Dayton, Ohio; Milwaukee, Wis.; Togus, Me.; Hampton, Va.; Leavenworth, Kan.; Santa Monica, Cal.; Marion, Ind.; Danville, Ill.; Johnson City, Tenn., and Hot Springs, S. D. In 1903 the aggregate number of inmates was about 27,000; in 1917 it was 32,000. The total number cared for up to and including 1917 is about 200,000.

The requirements for admission are: (1) An honorable discharge from the United States service. (2) Disability which prevents the applicant from earning his living by labor. (3) Applicants for admission will be required to stipulate and agree to abide by all the rules and regulations made by the board of managers or by its order; to perform all duties required of them and to obey all the lawful orders of the officers of the Home. Attention is called to the fact that by the law establishing the Home the members are made subject to the Rules and Articles of War and will be governed thereby in the same manner as if they were in the army of the United States. (4) A soldier or sailor must forward with his application for admission his discharge paper and when he is a pensioner, his pension certificate and if he has been a member of a State home, his discharge from that home, before his application will be considered; which papers will be retained at the branch to which the applicant is admitted, to be kept there for him and returned to him when he is discharged. The rule is adopted to prevent the loss of such papers and certificates and to hinder fraudulent practices, and no application will be considered unless these papers are sent with it. If the original discharge does not exist, a copy of discharge, certified by the War or Navy Department, or by the adjutant-general of the State, must accompany the application.

The United States Soldiers' Home at Washington, D. C., receives and maintains discharged soldiers of the regular army. All soldiers who have served 20 years as enlisted men in the army (including volunteer service, if any) and all soldiers of less than 20 years' service who have incurred such disability, by wounds, disease or injuries in the line of duty while in the regular army, as unfits them for further service, are entitled to the benefits of the Home. A pensioner who enters the Home may assign his pension, or any part of it, to his child, wife or parent, by filing written notice with the agent who pays him. If not so assigned it is drawn by the treasurer of the Home and held in trust for the pensioner. The board of commissioners consists of the general-in-chief commanding the army, the surgeon-general, the commissary-general, the adjutant-general, the quartermaster-general, the judge-advocate-general and the governor-general of the Home. About 1,500 old soldiers occupied the Home in 1917.

There are State homes for disabled volunteer soldiers provided by 27 of the States and New York, New Jersey, Washington and Nebraska each maintain two such homes.

Confederate soldiers' homes have been established in Atlanta, Ga.; Austin, Tex.; Beauvoir, Miss.; Columbia, S. C.; Hermitage, Tenn.; Higginsville, Mo.; Jacksonville, Fla.; Little Rock, Ark.; Mountain Creek, Ala.; New Orleans, La.; Pewee Valley, Ky.; Pikesville, Md.; Raleigh, N. C.; Richmond, Va.; Washington, D. C. There are of course very few veterans remaining to occupy them.

SOLDIERS THREE, by Rudyard Kipling, is thus well described in the title-page of the original edition, printed in 1888 in Allahabad by the Pioneer Press as Number 1 of A. H. Wheeler and Company's Indian Railway Library: ‘Soldiers Three.’ A Collection of Stories. Setting forth Certain Passages in the Lives and Adventures of Privates Terence Mulvaney, Stanley Ortheris and John Learoyd. Done into type and edited by Rudyard Kipling.

We be Soldiers Three
Pardonnez moy, je vous en prie.

Most of these tales are told in the inimitable language of the Irish member of the tri-partnership, Terence Mulvaney, whose humor, philosophy, strength and tenderness immediately endeared him to the reading public, and those stories in which the big Irishman plays the leading rôle, such the ‘The Taking of Lungtungpen,’ ‘The Incarnation of Krishna Mulvaney’ and ‘The Courting of Dinah Shadd,’ are unquestioned favorites; yet Mulvaney's associates, the little cockney, Ortheris, and the gigantic Welshman, Learoyd, are by no means to be slighted and much of the charm of the tales lies in the close friendship that binds the incongruous trio. In his ‘Views and Reviews,’ Henry James declares, “Mulvaney is a creation to be proud of and his two comrades stand as firm on their legs. In spite of Mulvaney's social possibilities, they are all three finished brutes; but it is precisely in the finish that we delight.” And the *Edinburgh Review* says, “Mr. Kipling paints the real man, with his natural blackguardism, softened and redeemed by a rough chivalry, by unexpected gleams of tenderness and by a strong feeling of comradeship toward his brothers in arms.” The revised editions, under the title ‘Soldiers Three and Military Tales,’ contain additional accounts of the adventures of the famous trio, together with other episodes relating to the British army in India, notably ‘The Man Who Was’ and ‘The Drums of the Fore and Aft.’

ARTHUR GUITERMAN.

SOLE, a European flatfish (*Solea vulgaris*), one of the most familiar of British food-fishes. The average length is about 12 inches and the weight about 18 ounces and the flesh is very palatable and nutritious. These fishes are usually captured by the trawl-net and sometimes by the line. They inhabit the shallow waters of sandy coasts and sometimes ascend rivers to spawn. Other species of soles are the lemon sole (*S. pegusa*), the variegated sole (*S. variegata*), which has a reddish-brown color marked with darker brown bands, and the solenette or little sole (*S. linguatulus*), the average length of which is about five inches. The transparent sole (*Achirus pellucidus*) of the Pacific Ocean, which wants the pectoral fins, and the zebra sole (*S. zebrina*) of Japan, are also well-known species. The nearest American representative is a small, closely allied fish, called hog-choker (*Achirus fasciatus*), common along the Eastern coast, but not regarded as worth eating.

SOLEMN LEAGUE AND COVENANT, The. A compact entered into in 1643 between England and Scotland for the “extirpation of popery and prelacy and the preservation of religious liberty” in the two countries. Two years later it was once more ratified in Scotland. Charles I refused his approval to the League; but Charles II thought it the better part of discretion to yield to the pressure brought upon him by the Protestant faction, which had already shown itself all powerful; so he took a solemn oath to observe all the provisions of the international covenant, a compromise he had no intention of keeping, and he succeeded in having the Scottish Parliament, in 1661, annul the “Solemn League and Covenant” and absolve the lieges from their obligations to it. Consult Hetherington, ‘History of Church of Scotland’; McCrie, ‘Sketches of Church History.’

SOLENHOFEN. See SOLNHOFEN.

SOLENOID, a primary form of electrical magnet, consisting of a filament, which, when enclosed by a spiral-conducting wire properly positioned with its ends brought to the middle, may become a magnet when engaged by a current; also called solenoid magnet.

SOLENT, England, the western part of the strait of the English Channel separating the Isle of Wight from the mainland. It is 15 miles long and almost three miles wide and forms a safe roadstead. A few miles north of the Neches the navigable channel narrows to three-quarters of a mile. It has been the scene of many famous yacht races.

SOLEY, sō'lĭ, **James Russell,** American naval historian: b. Roxbury, Mass., 1 Oct. 1850; d. New York, 11 Sept. 1911. He was graduated from Harvard in 1870 and in the following year was appointed professor in the Department of English at the United States Naval Academy at Annapolis. He was commissioned a commander in 1882 and stationed at Washington, D. C., in charge of the naval library there. From 1885 to 1889 he lectured upon naval history and international law in various Eastern colleges and in 1890 was appointed Assistant Secretary of the Navy. In 1893 he resigned this office and took up the practice of law in New York. He edited and conducted the publication of the naval history of the Civil War and is the author of ‘The Campaigns of the Navy in the Civil War’ (1883); ‘The Naval Wars of the United States’; ‘Maritime Industries of America,’ etc.

SOLF, Wilhelm, German linguist, economist and statesman: b. Berlin, 5 Oct. 1862. After completing his gymnasium course, he attended the universities of Berlin and Kiel (where he studied Sanskrit and Comparative Philology), returning in 1887 to Berlin to pursue courses in Hindu, Urdu and Persian, at the Berlin Seminary for Oriental Languages, taking his Ph.D. degree in this field. He later took up the study of law at the University of Jena. He has seen much of the world, chiefly in the service of the German foreign office and colonial office in Calcutta and elsewhere. In 1900 he became governor of Samoa, and late in 1911 was made Secretary of State for the colonies (*Staatssekretär des Kolonialamts*). Under the Provisional German government which arose at Berlin after the signing of the armistice of 11 Nov. 1918, Solf became Minister for Foreign Affairs, an appointment which was strongly criticized by the more radical sections of the Socialist party by reason of the fact that it was wrong to retain any of the officials of the former German government under the new «Socialistic» government. A Berlin message dated 26 Aug. 1919 announced the appointment of Dr. Solf as Ambassador of the German Republic to Great Britain. He is the author, in the philological field, of 'Die Kaçnûr-Rezension der Pañcâçikâ' (1886).

SOLFAING, sōl'fā-ĭng (from sol, fa, in the musical scale), the exercising of the voice upon the syllables do, re, mi, fa, sol, la, si (solmization) used to designate the notes of the diatonic scale. Pieces without text intended for this sort of exercise are called *solfeggi.* Sometimes this word is applied also to instrumental music, referring to exercises, merely intended to improve the learner in reading notes and hitting intervals. See SOL-FA SYSTEM; SOLFEGGIO.

SOLFATARA, the Italian name for a kind of volcanic vent found in various parts of the earth, which, though not in a state of actual eruption, gives out sulphurous gases and vapors. The most notable are found in Italy, in the Antilles, in Mexico, in the interior of Asia and in Java. Probably the best known are those between Rome and Tivoli and that at Pozzuoli, near Naples. This last is an irregular plain almost surrounded by the walls of an ancient crater. From the crevices rise steam and gases, chiefly sulphuretted hydrogen, mixed with minute quantities of muriatic acid and muriate of ammonia. The cracks and fissures of the rocks abound with sulphur, alum and sulphate of iron. Solfataric action is an important source of commercial sulphur deposits.

SOLFEGGIO, sŏl-fĕj'ĭ-ō, in music, a vocal exercise, in which the syllables ut (or do), re, mi, fa, sol, la, si — corresponding to C, D, E, F, G, A, B — are used instead of words. Their use as a method of nomenclature originated, as far as the first six are concerned, in the 11th century with Guido Aretinus, who substituted his hexachord system for the old Greek tetrachords. Observing in the melody of an ancient hymn for the festival of Saint John the Baptist, beginning

Ut queant laxis *Re*sonare fibris
*Mi*ra gestorum *Fa*muli tuorum
*Sol*ve polluti *La*bii reatum
*S*ancte *I*oannes,

that the notes on which the successive phrases began were identical in order with the sounds of the hexachord, he adopted the syllables to which they were allied in the above stanza as names to represent the degrees of his new scale. When early in the 17th century, the octave was completed by the seventh or «leading note,» the syllable Si, formed of the initials of «Sancte Ioannes,» was added; while Do generally took the place of Ut, as being more easily sung. This illustration of the construction of the musical scale by the use of the syllables is called solmization.

SOLFERINO, sŏl-fĕ-rē'nō, Italy, in the province of Mantua and 18 miles northwest of the town of that name. From its commanding position of the Plain of Lombardy, its tower has acquired the title of «Spy of Italy.» On 24 June 1859 the battle fought here between the Austrians on the one hand and the allied French and Sardinian troops, under Napoleon III, on the other, resulted in the defeat of the former. In this bloody conflict the Austrians lost 20,000 men, their adversaries 18,000. The population of the village is about 1,500.

SOLICITOR. See ATTORNEY; BARRISTER.

SOLICITOR-GENERAL, (1) an officer of the British Crown, next in rank to the attorney-general, with whom he is in fact associated in the management of the legal business of the Crown and public offices. The solicitor-general of Scotland is one of the Crown-counsel, next in dignity and importance to the lord advocate. (2) In the United States, a Federal official subordinate to the Attorney-General, whose duty it is to fill the latter's place in his absence. He is an appointee of the President, handles the business of the United States government with the Supreme Court and State courts and receives $10,000 annual salary.

SOLID, in geometry, a magnitude having three dimensions — length, breadth and thickness. A solid in physics is a body characterized by permanency of form; so much so, that the motion of one of its parts produces motion in the whole. As no materials have been proved absolutely permanent, adhering interminably to one form, there are no solids in the strictest sense; but the term is used of all things that normally retain their shape for a considerable time. We call cold butter solid, but it easily softens and melts. A ball of lead will flow under considerable pressure or with heat. A watch's mainspring is a solid, yet yields to a tiny force. When a solid piece of metal is strained beyond its limit of elasticity it fractures. The 13 geometrical forms of Archimedes, including the cube, octahedron, tetrahedron, dodicahedron, etc., are also technically termed solids. Hence a sphere, prism or other regular geometrical figure having magnitude is a solid. See ELASTICITY; LIQUID; MATTER.

SOLID-SHOT. See PROJECTILES.

SOLIDAGO. See GOLDEN-ROD.

SOLIDIFICATION, the passage of a substance into the solid state, either from a state of solution or fusion, or directly from the gaseous state. The term is usually applied, however, to the transition from the melted state into the solid form, and it is only in this sense that it will be here discussed. Some substances which are stable in the solid form cannot be melted without undergoing decomposition, either partial or complete; but many others can be converted into the liquid form by simple heating, passing back into the solid form again when the heat is abstracted. In general, fusion implies an addition of heat energy, and solidification implies its abstraction. Thus, to freeze one pound of water it is necessary to abstract from it an amount of heat energy that would be sufficient to raise the temperature of a pound of liquid water by about 140 degrees of the Fahrenheit scale; and in order to melt the pound of ice a precisely equal quantity of heat energy must be added to it again. All liquids may be divided into two general classes, whose laws of solidification are apparently very different. The first class includes bodies such as wax and glass, which, when they are cooled, pass into the solid state by a transition so gradual that it is impossible to assign any definite temperature at which the transformation can be considered to take place. The other class includes substances which, like water, do not begin to solidify until they have been cooled to a certain definite temperature peculiar to each substance. Solidification then begins at once, and it progresses continually, as the heat is abstracted, the temperature of the mass remaining unchanged until all of the liquid has been transformed into the solid form. In some cases the solid body that is obtained is crystalline in structure, and in other cases it is amorphous. In general, the temperature or solidification of a substance is identical with the melting point of the same substance; but in some cases the molten condition persists until the mass has been cooled to a temperature materially lower than the temperature of fusion. The rare metal known as gallium, for example, melts at 86° F.; but when once melted it may be cooled to about 36° F. before it solidifies. This phenomenon — the persistence of the molten condition after the substance has been cooled below the normal melting point — is called surfusion, and it may be regarded as analogous to the supersaturation that is sometimes observed in solutions (q.v.). If a small fragment of solid gallium be added to the molten metal at a temperature below 86° F., solidification at once ensues; and in general it may be said that in any fluid substance in a state of surfusion solidification is at once induced by the addition of a fragment of the same substance in a solid form. Some substances increase in volume when they pass from the molten to the solid state and others decrease. For example, when water solidifies it increases in volume so that the bulk of the ice that is formed is about one-eleventh greater than that of the original water. Bismuth, bronze and a few other metals which give good sharp castings also maintain an increase in volume upon solidification. Lead, iron and most metals, on the other hand, decrease in volume when fusing from the liquid to the solid state.

Pressure has a marked influence upon the temperature of solidification; and Dr. James Thomson showed, from theoretical principles, that under great pressures the temperature of solidification is lowered in bodies which expand upon solidification, and raised in those in which solidification is accompanied by contraction; this theoretical prediction having been subsequently verified by direct experiment.

SOLIDUNGULA, or PERISSODACTYLA, a division of the mammalian order *Ungulata* (q.v.), represented by the horses, asses, zebras, etc., distinguished primarily by the fact that the feet have each a single well-developed toe only, encased in a broad «hoof.»

SOLIDUS, a Roman coin originally called aureus (q.v.).

SOLINGEN, zō'lĭng-ĕn, Germany, in Prussia, in the Rhine province, stands on a hill bordering the Wupper River, 20 miles northeast of Cologne. It has Catholic and Protestant churches, a synagogue, schools of various grades, hospital, electricity and all the conveniences of a modern town. It is a centre of steel and iron industry in Germany. The municipality was established in 1374 and the town became famous for its sword-blades. There are numerous metal manufactories which turn out fine cutlery, copper and brass-ware, surgical instruments, etc., while several thousand workmen make small articles of cutlery at home. There are besides paper, linen, cotton, silk, soap and other factories. Solingen cutlery has been famous since mediæval times and is supposed to have been introduced by crusaders from Damascus. Pop. 50,000.

SOLIS, Juan Diaz de, hoo-än' dē'āth, dā sō-lēs', Spanish navigator: b. probably at Lebrija, Spain, about 1470; d. 1516. In 1506 he accompanied the navigator Pinzon in his expedition in search of a western passage to India, and upon this voyage touched the shores of Central America and explored the Caribbean Sea as far south as Honduras. In 1508 they reached lat. 40° S. and explored the Bay of Rio de Janeiro. In 1515 he sailed from Spain in command of three vessels with the expectation of making further progress in his quest of the Eastern world, and upon this voyage discovered the Plata, which was originally named for him. He was killed by the Indians upon this voyage.

SOLIS Y RIBADENEIRA, sō-lēs' ē rē'-vạ-dā'nē'ĕrạ, **Antonio de**, Spanish dramatist and historian: b. Alcala de Henares, 18 July 1610; d. 1686. Educated at the University of Salamanca, he there imbibed a strong love for literature and more especially for the stage; and already, at the age of 17, he had written a drama. At 22 he made a success with his play ‹Gitanilla,› which is still frequently seen in revivals of the Spanish stage. From this time on he continued to produce dramas, most of which met with popular favor. His reputation gained for him the position of royal secretary. This brought him into close connection with the royal family and, in a sense, shaped his life, making him one of the favorite dramatic writers of the private court theatre, and consequently of the theatres of the capital. Solis was a master of intricate plot and characterization, and as such was deservedly popular in his day, and some of the best of his dramas are still played in Spain. His Spanish is excellent and free from the exaggerated style of his age and his versification is very harmonious. He wrote many dramas, but his greatest work and the one by which he will probably be longest remembered is his ‹Conquest of Mexico,› which is one of the greatest histories ever written if it be judged from its literary and artistic excellence. Here his Spanish is almost perfect; his style rich, harmonious and beautiful and his handling of his subject is masterly. Yet his work has one great fault; he sees his whole story through the eyes of the Spanish adventurers and fails to comprehend that the exploited Aztecs had any rights, since Spain was Christian and they heathen. He is, therefore, out of sympathy with the great tragedy of his story, which is probably not strange when the age in which he lived is taken into consideration. Yet this one fault makes it fall short of being as really great a history as it is a literary work. The latter years of his life Solis, who never could successfully manage his pecuniary affairs and who was constantly in debt, retired to a monastery and ceased to write for the stage. Consult any good history of either Spanish or Mexican literature. A fair appreciation of his work is to be found in Ticknor's ‹History of Spanish Literature› (New York 1854).

SOLITAIRE, sŏl-ĭ-tār', (1) a flightless bird (*Pesophaps solitarius*), which has become extinct within comparatively recent times. It inhabited the islands of Bourbon and Rodriguez until about 1760. It was related to the dodo (q.v.), and was described by Leguat, a French voyager, who dwelt in the islands in 1691, and who says that the males were of a «brown-gray color,» the feet and beak being like a turkey's, but «more crooked.» He notes that the tail was inconspicuous in size, the hinder parts being rounded; the neck was straight and the eye black and lively. «They never fly,» says Leguat; «their wings are too little to support the weight of their bodies; they serve only to beat themselves and to flutter when they call one another.» Some of the males were said to weigh 45 pounds. (2) In America a myadestive bird, the fly-catching thrush, so called because of its shy habits. They are common in the West Indies and the Rocky Mountains. Consult Newton, 'Dictionary of Birds' (New York 1896); Rothschild, W., 'Extinct Birds' (London 1907).

SOLITAIRE, a game played by one person on a board indented with 33 or 37 hemispherical hollows, with an equal number of balls. One ball is removed from the board and the empty hollow thus left enables pieces to be captured singly as in draughts. The object of the player is to take all the pieces except one without moving diagonally or over more than two spaces at a time. The name is also applied to several card-games played by one person. They depend usually upon a system of «building» upward in piles, a «marriage» or bringing together of king and queen freeing the lower cards of a pile for rebuilding. See Cards.

SOLLY, Samuel Edwin, American physician: b. London, England, 5 May 1845. He studied medicine in London and practised there until 1874, at which time he came to America and settled in Colorado. He has published 'Handbook of Medical Climatology'; 'Tubercular Laryngitis'; 'The Influence of Altitude upon the Blood,' etc.

SOLMIZATION. See Solfeggio.

SOLNHOFEN (zōln'hō-fĕn) **BEDS** (Solenhofen incorrectly), deposits of a peculiar character in the Jurassic strata of Bavaria and deriving their name from the town of Solenhofen, near which and Mönsheim, Eichstädt and Hofstetten in the valley of the Altmühl, they are obtained. They have acquired a world-wide use as lithographic stone. The rock varies from a nearly pure carbonate of lime (over 99 per cent) to one in which a moderate amount of silica is present. These latter portions are very thin-bedded, often appearing to have a slaty structure. All are exceedingly fine and uniform in grain, representing the deposits of an impalpable lime-flour or lime-mud in quiet though shallow lagoons surrounded by growing coral reefs. These fine lime-mud rocks (Calcilutytes) are often rendered impure by the admixture of dust blown by the winds from the distant land and settling in the waters of the shallow lagoons. In these layers were imbedded dragon-flies and other insects, which were brought from the lands and whose remains, beautifully preserved, are found to-day in these thinner bedded and more impure layers, together with those of marine as well as other aerial animals. Most noteworthy among these latter are the flying reptiles, Rhamphorhynchus and Pterodactylus, and the primitive bird Archæopteryx, whose skeleton shows so many reptilian characters as to constitute this animal a veritable connecting link between reptiles and birds. See Lithography.

SOLOGUB, sŏl ō-goob, **Feodor**, the nom-de-plume of Theodore Kuzmitch Teternikov, Russian poet, novelist and playwright: b. 1863. He was educated at the Teachers' Institute of Petrograd and for several years followed the profession of teaching. In 1894 his story, 'Shadows,' published in the *Severny Vestnik*, proved so popular that he turned to the career of a man of letters. Poems, novels, fables, plays and short stories flowed in rapid succession from his pen for over 12 years before he attained his first large measure of success in 1907 with the novel, 'The Little Demon.' His creative genius has found its best literary vehicle in the short story; as a stylist he has had few peers, but his scenes are usually laid in the unpromising milieu of the smaller provincial towns of Russia. His 'Sweet-Scented Name and Other Stories' has been published in English (1915).

SOLOMON: b. probably between 1033 and 993 B.C.; d. between 980 and 920 B.C.; the son of David, king of Israel, by Bathsheba, formerly the wife of Uriah, was appointed by David to be his successor in preference to his elder brothers. He ascended the throne between 12 and 14 years of age and reigned 40 years. His age is usually given as 53 at death. By his remarkable judicial decisions, and his completion of the political institutions of David, Solomon gained the respect and admiration of his people; while by the building of the temple, which gave the Hebrew worship a magnificence it had not hitherto possessed, he bound the nations still more strongly to his throne. He put to death Adonijah, Joab, Shimei and others whom he deemed enemies and married a daughter of Pharaoh besides women of nearly all the neighboring principalities to increase his influence and prestige. He built up a foreign commerce previously unknown. The wealth of Solomon, accumulated by a prudent use of the treasures inherited from his father; by successful commerce; by a careful administration of the royal revenues, and by an increase of taxes, — enabled him to meet the expense of erecting the temple, building palaces, cities and fortifications and of supporting the extravagance of a luxurious court. He extended his dominions from the Euphrates to the Philistine and Egyptian borders. He had a trading agreement with King Hiram of Tyre and received rare wood and other articles for the temple. Solomon chose influential men as his advisers, and himself attained a reputation of being one of the wisest of mankind. His fame was so great that the queen of Sheba traveled 1,500 miles to interview him. Many biblical and profane stories are told of his miraculous powers and prophetic ability. He knew better than to engage in war, but he maintained a considerable standing army, including 1,200 cavalry and 4,000 armed chariots.

Fortune long seemed to favor this great king, and Israel, in the fulness of its prosperity, scarcely perceived that he was continually becoming more despotic. Contrary to the laws of Moses, he admitted foreign women into his harem; and from love of them he was weak enough in his old age to permit the free practice of their idolatrous worship, and even to take part in it himself. Toward the close of his reign troubles arose in consequence of these delinquencies, and the growing discontent, coming to a head after his death, resulted in the division of the kingdom, which his feeble son Rehoboam could not prevent. The 40 years' reign of Solomon is still celebrated among the Jews for its splendor and its happy tranquillity, as one of the brightest periods of their history. The writings attributed to Solomon are the Book of Proverbs, Ecclesiastes and the Song of Solomon, with the apocryphal book the Wisdom of Solomon; but modern criticism has decided that only a portion of the Book of Proverbs can be referred to Solomon.

Students of Hebrew and Arabic works appear to agree that Solomon is much overrated by the biblical narrative, and that there was nothing in his career to deserve his being placed among the world's great men. Consult Alexander, 'King Solomon' (1897); Farrar, 'Solomon'; Hallock, 'Child's History of King Solomon'; Hirsh, E. G., 'Solomon' (in 'Jewish Encyclopedia,' New York 1907); Winterbotham, 'Life and Reign of Solomon.'

SOLOMON, Solomon Joseph, English painter: b. London, 16 Sept. 1860. He studied art at the Royal Academy schools, Munich Academy and the Ecole des Beaux Arts, Paris, and subsequently did much work during his travels in Italy, Spain and Morocco. Among his pictures are 'Cassandra' (1886); 'Sampson' (1887); 'Niobe' (1888); 'The Judgment of Paris' (1890); 'Echo and Narcissus' (1894); and many portraits.

SOLOMON, Odes of, a collection of 42 hymns by an unknown author, «Solomon» being a pseudonym. They were probably written toward the end of the 1st century, and possibly are the work of several writers. They are quoted in the gnostic book of the 3d century, 'Pistis Sophia' and in the 'Institutes' of Lactantius. They were discovered by Dr. J. Rendel Harris in 1908 in a 16th century Syriac manuscript in his possession, which contained also the 'Psalms of Solomon' (q.v.). The manuscript was made from the Greek and was mutilated so that the series begins with a fragment of the third ode. The first ode, however, has been restored from 'Pristis Sophia.' While they are undoubtedly of Christian origin they resemble the New Testament only slightly. Many of them are of Jewish atmosphere, which induced Harnack's theory that they were of Jewish origin and were revised early in the Christian era. Opinion generally admits them to be purely Christian, Harris placing most of them between 75 and 100 A.D. In the 'Pistis Sophia' they are assumed to be almost wholly derived from the canons of Scripture. Consult Harris, J. R., 'The Odes and Psalms of Solomon' (1909); Fleming, J., and Harnack, A., 'Ein Jüdischchristliches Psalmbuch' (1910); Conybeare, F. C., 'The Odes of Solomon Montanist' (1911).

SOLOMON, Psalms of, a collection of 18 hymns of Pharisee authorship and unwarrantably credited to Solomon. They were undoubtedly first written in Hebrew, but they are now extant only in Greek manuscripts and in a Syriac transcript from the Greek discovered by Dr. J. R. Harris in 1908. The period of their authorship is fixed at 70–40 B.C. Apparently they were written by two authors, the psalms dealing with the hopes for a Messiah being dissimilar in type to the others in which the Hasmoneans are charged with usurping the throne of David and unrightfully occupying the high-priesthood. The psalms are practically ignored by early Christian writers, but were in good standing in the Jewish Church and were used in the synagogues. Consult Ryle, E. H., and James, A., 'Psalms of the Pharisees, commonly called the Psalms of Solomon' (1891); Von Gebbart, O., 'Die Psalmon Salomos' (1895); Harris, J. R., 'Odes and Psalms of Solomon' (2d ed., 1911).

SOLOMON, Wisdom of. See WISDOM, BOOK OF.

SOLOMON ISLANDS, Melanesia, a group of islands in the Pacific Ocean, belonging to Great Britain and situated between lat. 5° and 11° S., and between long. 154° and 162° 30′ E. It is an irregular chain stretching in a southeast direction from New Pomerania toward the New Hebrides, 1,000 miles off the northeast coast of Australia. The group consists of the large islands of Bougainville, Choiseul, Ysabal, Malaita, New Georgia, Guadalcanar and San Cristoval, arranged in two parallel rows and a large number of small islands. Bougainville, the largest, is 120 miles long and 35 miles wide and the other islands named above are but little smaller. The total area of the group is about 16,950 square miles. Bougainville, Buka and some contiguous islands were governed by Germany up to 1914, when they were captured by an Australian force. The islands are all elongated from northwest to southeast, and mountainous, rising in Bougainville to a height of 7,760 feet. There are two active volcanoes and numerous extinct craters and active hot springs. The surrounding waters are beset with coral reefs which make navigation dangerous. All the islands are heavily forested, and vegetation is very luxuriant. The inhabitants are Melanesians. They have had but little communication with Europeans and are still savages, practising cannibalism and polygamy. They cultivate the soil and are very skilful in boat-building and wood carving. Their number is estimated at 200,000, while the European population is less than 100, mostly missionaries. The chief products of the islands are copra, trepang, pearl, tortoise-shell and sandal wood. The islands were discovered by Mendaña in 1564. By the Anglo-German conventions of 1886 and 1899 the protectorate of the islands was divided so that Germany retained Bougainville and its neighboring islets, while the remaining islands came under the protection of Great Britain. By the Peace Treaty promulgated 28 June 1919 Germany was deprived of her portion of the islands, amounting in area to 4,200 square miles, which was placed under Australian administration. Consult Guppy, H. B., 'The Solomon Islands' (1887); Woodford, C. M., 'A Naturalist Among the Head Hunters' (London 1890).

SOLOMON'S SEAL, common liliaceous plants (*Polygonatum*) arising in copses from thick, white, fleshy rootstocks. These bear circular scars left by each annual stem, upon its decay; by some, these are said to be the "seals," while others state that the name refers to the seal-like markings seen when the stem is cut across. The European *Polygonatum multiflorum,* and the American *P. biflorum* are much alike, and *P. commutatum* chiefly differs by being more glabrate and smaller. The Solomon's seals are now cultivated especially in wild gardens. They are apt to grow in colonies and have slender, tough stems, bending until nearly horizontal under the weight of the numerous, sessile, broadly lanceolate leaves, which are arranged closely, alternately and flatly on either side of the top of the stem. Under this protecting roof hang bell-like, three-parted flowers, generally in pairs on forked axillary peduncles. They are small, greenish in hue and succeeded by globular berries, very dark blue, with a bloom.

False Solomon's seals or wild spikenard (*Vagnera racemosa* and *V. stellata*) are similar liliaceous but less graceful plants. They do not have seals on the roots, are likely to be larger, with pubescent and longer leaves; and the starry white flowers are gathered in panicles or racemes at the end of the drooping stems. The berries are either red speckled with purple, or green striped with black. *V. racemosa* is sold by city florists in its season.

SOLON, sō'lòn, Athenian law-giver: b. Athens, about 640 B.C.; d. about 559. He was of a noble family and some of its members were ancestors of Codrus. Solon in early life became a trader, gathering by travel a fund of observation and experience, and thus became enrolled among the Seven Wise Men of Greece. His first appearance in public life was during the contest between Athens and Megara, for the possession of Salamis, a question he decided by quoting a passage of Homer in which Ajax is described as belonging to the Athenian armament. He appeared again as a promoter of hostilities against Cirrha in behalf of Delphi, and moved the Amphictyons to declare war. He was made archon about 592 or 594, at a time when the laws, too favorable to the rich, had overburdened the poorer classes to a critical point inviting revolution. His preliminary measures consisted of a "disburdening ordinance" intended to alleviate the burdens of the debtor class without doing injustice to the creditor; a rearrangement of the monetary system, and a measure to control the rate of interest and the acquisition of land. So successful did these reforms prove that he was charged with the remodeling of the constitution. He began by abolishing all the laws of Draco, except those relating to homicide, and established the right to citizenship on a basis of property qualification. He divided the people into four classes: (1) Pentacosiomedimni, those having a yearly income of at least 500 *medimni* (750 bushels) of corn, or *metretæ* of wine or oil; (2) Hippeis, Knights, those having 300 *medimni;* (3) Zeugitæ, those possessing a yoke of oxen with 150 *medimni;* (4) Thetes, workers for wages, those with less than 150 *medimni* as yearly income. The archons could only be chosen from the first class. Members of the first three classes were alone eligible for responsible offices and with them lay the election to such offices. The Thetes were ineligible to office, but could vote in the general public assemblies. Solon among other things regulated the levying of taxes and the military service of the citizens. He also established the Council of the Four Hundred. His system tended to reduce debts and give greater opportunity to those in the lower classes; his code of laws regulated public and private life. He also reformed the calendar and the system of weights and measures. He regulated and reduced dowries, restricted prostitution, compelled fathers to teach trades to their sons and ordered that at stated periods each citizen must report how he earned his living. The laws he made were inscribed on wooden cylinders and triangular tables and set up in public. He acknowledged, however, that these laws were not the best conceivable, but the best that the Athenians could be made to accept.

The remainder of his history belongs to the borderland of legend. He is said to have exacted a pledge from the Athenians that they would not change his laws for 10 years and to have left the state for Egypt, Cyprus and Lydia. He returned to find the old dissensions renewed in a state which was destined in a short time to fall under the tyranny of Pisistratus. Consult Gilliard, 'Queques Reformes de Solon' (Paris 1907); Lehmann-Haupt, 'Solon of Athens' (Liverpool 1912). See ATHENS.

SOLOVIEV, sō-lō-vyĕf, **Vladimir Sergeievitch,** Russian philosopher and religious writer: b. Moscow, 16 Jan. 1853; d. 31 July 1900. He was the son of the historian Sergei Soloviev and naturally grew up with the companionship of books. A born mystic, he in early youth passed through the stages of scepticism into a profound belief into a creed not clearly defined, but sufficient for himself. He was graduated from the University of Moscow in 1874 with a dissertation on "The Crisis of Philosophy in Western Europe," and shortly after visited France, Italy, England and Egypt. He was appointed to an associate professorship in the University of Saint Petersburg in 1877, which he held till 1881, when his plea for pardon on behalf of the assassin of Alexander II led to his dismissal and brought him into collision with the Holy Synod and its procurator, Pobiedonostseff. For the rest of his life Soloviev engaged in religious and philosophical writing, pouring out a vast variety of volumes with amazing fecundity. He acquired a deep knowledge of Hebrew and defended the Russian Jews against official persecution. Some of his works have long been translated and circulated in France and Germany, where they aroused considerable interest, but English readers have as yet been unable to learn much about a remarkable man who for a generation exerted a profound religious influence over his countrymen. His works hardly reveal a master philosophical thinker; his speculations rather leave the impression of being assimilated, taking over systems imported from the West and restating them in some extreme form, daring but not always original. At the age of 24 he wrote the 'Philosophical Principles of Integral Science'; the 'Critique of Exclusive Principle' and 'The Justification of Good' are obscure, fragmentary and discursive — displaying a disability of dissociating religion and morality from truth.

Like Newman, his spiritual pilgrimage led him to embrace the Roman Catholic Church, but there the resemblance ends. Newman was faced with the alternatives of blind belief or limitless unbelief; to Soloviev, belief was a necessity; convinced at the outset of the truth of Christianity, it only remained for him to choose the form. His admirers have referred to him as «the Russian Newman,» «the Russian John the Baptist» and «the William James of Russia.» None of these descriptions is accurate. Soloviev was not a dialectician; his conclusions do not conform to logical rule; he was truly Slavic in his spiritual mobility or instability; quickly receptive even of inconsistent doctrine, and aspiring after things that were hard or impossible to reconcile. The philosopher became absorbed in the religious teacher and reformer. He labored not only for a reunion between the Orthodox and the Roman Catholic churches, but for a general religious unity. His encyclopedic variety of literary productions and multifarious propaganda have recently begun to find their way into English; only his brilliant dialogue on 'War and Progress' and 'The Justification of the Good' (1919) have been translated. Consult d'Herbigny, M., 'Vladimir Soloviev' (London 1918).

SOLSTICE, *in astronomy,* either of the points in the ecliptic, midway between the equinoxes, at which the sun appears to stop or cease to recede from the equator, either north in summer or south in winter (considered from a northern hemisphere viewpoint). There are two solstices — the summer solstice, the first degree of Cancer, where the sun is about 21 June; and the winter solstice, the first degree of Capricorn, where the sun is about the 22 December. The time at which the sun is at either of these points also receives the same name.

SOLUTIONS. In chemistry and physics a solution is usually defined as a homogeneous liquid in which two or more chemically distinct substances are simultaneously present. Many authorities, however, restrict the term to such homogeneous liquid mixtures as exhibit a definite osmotic pressure (see below). Others extend it so as to make it include gaseous mixtures, and even solid mixtures such as alloys. In the present article we shall adopt the former course, using the term to signify a homogeneous liquid mixture, which is capable of exerting a definite osmotic pressure.

When a solid substance is dissolved in a liquid, the liquid is called the «solvent,» and the solid is called the «solute.» When a solution is prepared by mixing two liquids, either one of the liquids may be regarded as the «solvent,» the other then being called the «solute»; but it is customary to consider the one which is present in largest amount as the «solvent.» By way of illustrating these terms, let us suppose that approximately equal masses of water and of anhydrous liquid carbolic acid are shaken up together. The two will not mix freely at ordinary temperatures, but the water will take up a small quantity of the acid, and the acid will similarly take up a small quantity of the water; the mixture subsiding, when the agitation ceases, into two distinct layers, carbolic acid preponderating in the lower one, and water in the upper one. The upper layer may then be regarded as a solution of carbolic acid in water, and the lower as a solution of water in carbolic acid; carbolic acid being the «solute» in the upper layer, and the «solvent» in the lower one. This distinction is evidently an arbitrary one, however, and many cases could be cited in which it would be impossible to assign any reason for regarding either constituent as the «solvent,» in preference to the other one. For example, carbolic acid and water dissolve in each other more and more freely as the temperature rises, until, at temperatures above 183° F., they mix readily in all proportions. If equal masses of these substances were mixed at 185° F., therefore, we could regard either as the solvent, and either as the solute.

When a solid substance is dissolved in a liquid, it sometimes happens that there is no marked evidence of chemical change. In other cases, however, there is a very obvious chemical change. When ordinary cane sugar is dissolved in water, a syrupy liquid results, from which the sugar may be again obtained in the same chemical condition as at first, by allowing the water to evaporate at a sufficiently low temperature. If sodium hydroxide, on the other hand, is added to a given mass of hydrochloric acid until the acid is just neutralized, it is impossible to obtain either the acid or the sodium hydroxide by mere evaporation of the solution. Nothing but water passes away in the vapor, and the solid substance that remains behind when the water is all gone is found to be common salt. If we choose to do so, we may regard the mixture of sodium hydroxide and hydrochloric acid as a solution of the hydroxide in the acid; but since we may prepare identically the same ultimate mixture by adding common salt to pure water, it is perhaps more convenient to regard it as a solution of common salt in water. For the present we shall take the latter view, confining our attention solely to those cases of solution in which a solid dissolves in a liquid without any obvious chemical change.

When a solid is added to a liquid for which it has no chemical affinity, it may remain entirely unaffected. In this case, the solid is said to be «insoluble» in the liquid, and no solution is obtained. If the solid is not insoluble in the given liquid, it gradually disappears when the two are brought together, the part which ceases to be visible passing into the liquid in the dissolved state. In some cases the change is rapid and in others it is slow. It is always accelerated by agitating the solvent. Some solids appear to mix with certain solvents in all proportions; but in general it will be found that if the supply of the solid is sufficient there will come a time when, under the conditions of the experiment, no more of the solid will dissolve. The solution is then said to be «saturated.» The quantity of a given solute that will dissolve in a given solvent depends upon several circumstances, but most notably upon the temperature of the solvent, nearly all substances being more soluble at high temperatures than at lower ones. If a saturated solution of a substance that is more soluble at high temperatures than at lower ones is warmed, it becomes capable of taking up more of the solute; and if such a saturated solution is cooled, it usually deposits some of the solute, until its degree of concentration becomes reduced to that corresponding to saturation at the lower temperature. It is sometimes possible, however, to cause a solution to retain more of the dissolved solid than corresponds to saturation at a given temperature; though this «supersaturated» condition is quite unstable. Glauber's salt (that is, sulphate of sodium crystallized with 10 molecules of water), exhibits supersaturation in a marked manner. If a saturated solution of this salt be prepared at a certain definite temperature, and then removed from contact with any particle of the free, undissolved salt, its temperature may be lowered by a considerable amount before crystallization sets in. If the smallest fragment of the solid salt is placed in such a supersaturated solution, crystallization at once begins, proceeding rapidly until the concentration is reduced to that corresponding to normal saturation at the temperature at which the experiment is performed. Pressure appears to influence the solubility of a substance to a measurable extent, but the effect of a change of temperature is, in general, far more marked.

A solution which is far from being saturated, by reason of the solvent being present in great excess, is said to be «dilute.» The physical phenomena manifested by dilute solutions are much more simple than those of solutions that are nearly saturated, in precisely the same way that the phenomena exhibited by an attenuated gas are simpler than those exhibited by the same gas in a strongly compressed state.

A solution which is not homogeneous throughout with respect to concentration, but which is dilute in some places and approximates to saturation in others, tends to become of uniform concentration throughout, by a process known as «diffusion.» This consists in the gradual passage of the dissolved solid away from those regions in which the concentration is greatest and toward those in which it is least. This tendency was first discovered by Parrot, in 1815. It was experimentally investigated by Graham (1850), so far as concerns its manifestation in solutions whose internal motions are not restricted in any way; and Fick, in 1855, gave the fundamental mathematical theory of the process. In Fick's theory it was assumed that the quantity of dissolved salt which diffuses across a given sectional area of the solution in a given time is proportional to the rate of variation of the concentration of the solution per unit of length of the straight line that is perpendicular to the sectional area under consideration. This is entirely analogous to the assumption made by Fourier with regard to the conduction of heat through a solid; and, therefore, Fick was able to apply the results of Fourier's powerful analysis directly to the problem of diffusion in liquids. The subject being essentially mathematical in nature, reference must be made, for further particulars, to the works cited at the end of this article.

It was known in the 18th century that if a glass vessel is filled with alcohol and the opening is tightly covered with a bladder, and the whole is then immersed in water, the contents of the vessel increase so that the bladder is distended and sometimes bursts. This is evidently due to the fact that water enters the closed vessel by passing through the more or less porous bladder. In other words, it is a diffusion phenomenon, which takes place between two parts of a non-homogeneous fluid system, which are separated from each other by means of a partially permeable partition. The systematic study of diffusion phenomena of this kind has led to many interesting and important results. Pfeffer (1877), by improving upon a suggestion due to Traube (1867), prepared diaphragms that were far superior to the bladders used by earlier experimenters; his method consisting in forming a precipitate of ferrocyanide of copper within the pores of a cell of porous earthenware. The earthenware, as thus prepared, was rendered «semi-permeable,» inasmuch as it would allow of the passage of water through itself, while it would not permit of the passage of any dissolved substance that the water might contain. The porous cell, as thus prepared, was filled with a solution of some substance such as sugar or nitre, and was then carefully sealed up, save for one small opening to which a delicate mercury manometer was attached. The prepared cell being then immersed in a vessel of pure water, it was found that water will enter the cell, until the mercury manometer registers a very considerable pressure;— a pressure of three atmospheres being observed in the case of a 1½ per cent solution of nitre. The passage of a liquid in this manner through a membrane or other porous septum is called osmosis (q.v.), and the maximum or limiting pressure that is attained when the system arrives at its ultimate condition of equilibrium is called the «osmotic pressure» of the solution. The osmotic pressure produced by any given solution is found to be proportional to the concentration of the solution, this relation being surprisingly accurate so long as the solution does not approach too closely to saturation. The osmotic pressure is further found to vary with the temperature of the solution; and the remarkable fact has been brought to light, partly by experiment and partly by theory, that for any given solution of constant concentration, the osmotic pressure is approximately proportional to the absolute temperature. De Vries has also shown that for non-electrolytes (such as solutions of sugar or glycerine in pure water), solutions of different substances possess the same osmotic pressures, provided their temperatures are the same, and they contain the same number of gram-molecules of dissolved substance per unit mass of the solvent. (A «gram-molecule» of any substance is a quantity such that its weight, in grams, is numerically equal to the molecular weight of the substance). It is evident, therefore, that the osmotic pressure of a dilute solution follows laws that are closely analogous to those that hold true for attenuated gases. Much of the modern theory of solutions has been built up on this fact; and while some of the reasoning by which students of physical chemistry draw upon the known facts of gaseous thermodynamics for information concerning solutions appears to be more or less imperfect, it must be admitted that the known analogies between attenuated gases and dilute, non-electrolytic solutions are highly interesting and suggestive.

Blagden, in 1788, showed that the freezing point of a salt solution is lower than that of pure water by an amount which is nearly proportional to the concentration of the solution, so long as the solution does not approach too nearly to saturation. Other investigators have examined this subject from time to time, and especially Raoult (1882), who worked with many different solutes, and with several solvents. Raoult's general conclusion was, that in any given solvent the freezing point is lowered by the same amount, by the presence of one gram-molecule of any dissolved substance whatever. This law is somewhat too general, as it has exceptions which cannot be here discussed; but it is sufficiently general and sufficiently accurate to be of material service in the determination of the molecular weights of substances whose percentage compositions are known by other methods. Raoult found also that the boiling point of a solvent is raised by the presence of a dissolved substance, the elevation being here also proportional to the concentration of the solution, and being, for any one solvent, independent of the nature of the solute, so long as the same number of gram-molecules of the solute are present in every case. This law is also subject to exceptions; but, like the freezing point law, it is very useful. In the determination of molecular weights by either of these methods, it must be remembered that the molecular weight of a substance may be (and indeed often is) different when the substance is considered in different physical states. Beckmann, for example, found that the boiling point of carbon disulphide is raised by sulphur by an amount which indicates that the molecule of sulphur contains eight atoms, when that element is dissolved in carbon disulphide; previous experiments on the vapor density of sulphur indicating that in the vaporous condition its molecule contains six atoms.

In a general way, the ultimate nature of the process of solution is explained by the molecular theory of matter (see MOLECULAR THEORY); but the molecular theory still leaves much to be desired on this score. We are to think of the solid solute as composed of a system of molecules, held together by the inter-molecular attractive forces that cause the parts of solids to cohere to one another. When the solute is placed in the solvent, the external attractive force of the solvent upon the superficial molecular layers of the solute partially neutralizes the internal forces by which these molecules are held in position, and more or less of the molecules of the solid escape into the solvent. As the concentration of the solution increases, an increasing number of the dissolved molecules will again come within the range of attraction of the undissolved portion of the solute, in such a way as to be caught by the solute, and temporarily retained as a part of it. Saturation occurs when the number of molecules regained by the solute in this way in any given time becomes equal to the number lost by it in the same time. Saturation being thus determined by the equality of the molecular exchanges that take place in a given time at the surface of the undissolved solute, it is evident that when no free solid is present there can be no such equality of exchanges. Hence the possibility of a «supersaturated» solution. Indefinite supersaturation cannot be experimentally realized, however, for in the ceaseless rearrangement of molecules that takes place in a liquid, it occasionally happens that a certain number of molecules of the dissolved substance fortuitously come together in such a way as to serve as a nucleus for the deposition of the solid; and when this occurs, the supersaturated solution spontaneously deposits the excess of solute that it contains.

The molecular condition of the dissolved portion of the solute has been made the subject of much study. When a solute dissolves, its dissolution is almost invariably accompanied by thermal changes, the solution becoming either cooled or heated. By reason of these thermal changes, the phenomena of solutions may be discussed by the aid of the general laws of thermodynamics (q.v.), without making any special hypotheses as to the ultimate molecular nature of the solution. This plan was carried out with great power by Gibbs, in his celebrated paper entitled 'On the Equilibrium of Heterogeneous Substances' (Transactions of the Connecticut Academy of Sciences, October 1875). His paper is so exceedingly general, and so entirely mathematical, that it is very difficult to read; and hence his methods are not understood, even yet, as widely as they should be. Van't Hoff and Arrhenius, attracted more to the purely physical side of the question, and desiring to form (if possible) some sort of a mental image of the actual processes that are going on, have developed a theory regarding the nature of the dissolved solute, which is known as the «ionic theory,» or as the «electrolytic dissociation theory»; and it is this theory which is most widely accepted at the present time. It has at least the merit of being suggestive, as well as fruitful in its practical results. There is also a so-called «hydrate theory» of solutions, in which the solute, in aqueous solutions, is supposed to form a series of definite hydrates with the solvent; analogous compounds being also formed in non-aqueous solutions. This theory has had many distinguished supporters, among whom the great Russian chemist Mendeléeff may be specially mentioned. In recent years its most devoted apostle is perhaps S. U. Pickering, who has defended it with ingenuity and power. The literature of the hydrate theory is not extensive, however, when compared with that of the ionic theory; and the ionic theory has the decided preference among physical chemists at the present time. A general presentation of the hydrate theory, written by Mr. Pickering, will be found in Watts' 'Dictionary of Chemistry,' article «Solutions II.»

According to the ionic theory of Van't Hoff and Arrhenius, the solute, in a solution, is dissociated more or less completely into little bodies called «ions»; the dissociation being slight or even zero in some cases, and very extensive in others. In a solution (such as that of sugar in water) which does not conduct electricity electrolytically, there is little or no «ionization,» or dissociation of the solute molecules into ions; while in a salt solution, which does conduct electrolytically, the dissociation is large, and may even be almost complete, when the solution is very dilute. The ions are not necessarily identical with the atoms, although they may be so in certain cases. When sulphuric acid and water compose the solution, the sulphuric acid is supposed to be partially dissociated into hydrogen and «sulphion» (SO_4); sulphion being a hypothetical «ion,» supposed to be present in the solution, but being admittedly incapable of existence in the free state. In the same way, sodium chloride, NaCl, when dissolved, is supposed to be more or less completely dissociated into the ions Na and Cl. It will be observed, however, that the ions are here *atoms* of sodium and chlorine, and not *molecules;* the molecules of these substances having the respective formulæ Na_2 and Cl_2, and being, therefore, composed, in each case, of two ions joined together. Here, as in the case of sulphion, the ions are seen to be incapable of free existence; because when the sodium and the chlorine are set free, by electrolysis or otherwise, it is a *molecular* aggregate that is obtained, and not a collection of the free ions. The completeness of the ionization of a solute is affected by various circumstances, but most notably by the degree of concentration of the solution; and the proportion of the solute molecules that are dissociated in any given solution may be numerically determined by various methods, for which the special works on solutions must be consulted. It is important to observe that ions are entirely different things from "electrons," the electrons being the ultimate particles of which the atoms are supposed to be built up, while the ions are either the atoms themselves, or else larger systems composed of the atoms. (See ELECTRON THEORY). The dissociated ions in a solution are supposed to be endowed with electric charges, the two ions into which any given molecule is separated being charged oppositely. In the case of sodium chloride, for example, the sodium ion is charged positively and the chlorine ion negatively. Upon the evaporation of the solvent, these ions recombine, their electric charges then neutralizing each other, so that the molecule, as a whole, is not electrified. There is no immediate evidence, in a solution, of the existence, within it, of electrified particles, or "ions"; but if an electrical stress is excited across the solution, by inserting the electrodes of a galvanic battery at opposite sides of the containing vessel, the postively electrified ions are urged one way, and the negatively electrified ones the other way. Eventually the ions, thus urged along, come in contact with the electrodes themselves, and here the ions discharge their electricities, becoming thereby capable of existing in the free state again, and being, in fact, deposited upon the electrodes, unless prevented by some secondary action within the cell. It will be observed that electrical conduction through an electrolyte is entirely different (according to the ionic theory) from conduction through solid conductors like metallic wires. The ions in a solution transport their charges bodily and pour them out upon the electrodes. The charge of an ion is supposed to be perfectly definite in magnitude; and hence Faraday's law, that electrolytic decomposition is accurately proportional to the total quantity of electricity passing through the electrolyte, is easily understood. It might be even better to state it in the inverse form; namely, that the quantity of electricity conveyed across an electrolytic solution, under a given electric stress, is accurately proportional to the total quantity of matter set free upon the electrodes. In a solution which does not conduct electricity, the reason that it does not conduct is supposed to be, that the molecules of the solute are not dissociated into ions to any important extent, so that they are incapable of being electrically charged, and are, therefore, incapable of acting as conveyors of electricity.

A single example may be given of the application of the molecular theory of solutions to the explanation of chemical equilibrium and mass action. Suppose that *m* gram-molecules of ethyl alcohol, one gram-molecule of acetic acid and *n* gram-molecules of water are mixed and the solution is allowed to stand indefinitely. The acetic acid $H.C_2H_3O_2$, combines with the alcohol, $C_2H_5.OH$, to form ethyl acetate, $C_2H_5.C_2H_3O_2$, and water, H_2O, in accordance with the equation: $H.C_2H_3O_2+C_2H_5.OH=C_2H_5.C_2H_3O_2+H_2O$. But the reaction proceeds very slowly, so that several days elapse before a state of approximate equilibrium is attained; and even then the solution will contain free acetic acid and free alcohol, the amounts of these that remain uncombined depending upon the relative quantities of the several constituents that were present in the original solution; — that is, upon *m* and *n*. (It is this dependence upon the relative quantities of the reacting substances that is understood when we speak of the "effect of mass" in chemical reactions; or, more briefly, of "mass action"). Suppose, now, that after a certain time, there have been x gram-molecules of ethyl acetate formed in the course of the reaction. This implies that there have also been x gram-molecules of water formed at the same time, and x gram-molecules, each, of acetic acid and of alcohol destroyed. At the instant contemplated, the number of gram-molecules of each of the several substances present in the solution will, therefore, be as follows: Of alcohol, $(m-x)$; of acetic acid, $(1-x)$; of ethyl acetate, x; and of water, $(n+x)$. The number of actual molecules of alcohol and of acetic acid present in the solution at this time will, therefore, be proportional to $(m-x)$ and to $(1-x)$, respectively; and hence the number of chance encounters, during one second, between a molecule or acetic acid and one of alcohol will be proportional to the product of these quantities, or to $(m-x)\ (l-x)$. We may assume that the number of actual combinations taking place under these circumstances will be proportional to this number of encounters, and to a certain (as yet unknown) coefficient of "affinity" between the two substances, which coefficient we will denote by k. The total number of gram-molecules of ethyl acetate formed during the next following second may, therefore, be taken as $k(m-x)$ $(1-x)$. Now if we had started our experiment by mixing ethyl acetate with pure water, we should have found that the water and the ethyl acetate would combine to form alcohol and free acetic acid, as indicated by reading the foregoing chemical equation from right to left; the reaction, in that case also, proceeding only to a definite point, and then ceasing. In the actual case we must conceive of both of these reactions as going on simultaneously. There being x gram-molecules of ethyl acetate present at the proposed instant, and $(n+x)$ gram-molecules of water, and the "chemical affinity" of water for ethyl acetate being supposed to be measured by a new coefficient, k', we conclude, by a process of reasoning entirely analogous to that just explained, that in the next following second the number of gram-molecules of ethyl acetate that will be decomposed will be $k^1\ (n+x)x$. When equilibrium is finally established, so that ethyl acetate is no longer formed or decomposed (that is, when it is formed and decomposed with equal rapidity), we have the equation $k(m-x)\ (1-x)=k'(n+x)x$. By trying the experiment with known initial quantities of acetic acid, alcohol and water, we could ascertain, directly, the value of x, which now represents the number of gram-molecules of ethyl acetate present when equilibrium is attained; and substitution in the foregoing equation would then give us the ratio of k to k',— that is, it would give us the ratio of the actual chemical affinities that are involved in this reaction. It has been found, in this way, that if we make (initially) $m=1$ and $n=0$, then when equilibrium is attained, the resulting value of x is ⅔. Substituting this for x, and putting 1 for m and 0 for n, we easily find that $k/k'=4$. With this value of the ratio of k to k', we may write the foregoing equation in the form $3x^2-(4+4m+n)x+4m=0$. This is a quadratic equation, and in order to find the final state of equilibrium for any proportion of alcohol and water to acetic acid in the original solution, we have merely to substitute for m and n their values as given for the primitive solution, and then solve for x. The equation, being a quadratic, has two roots; but no trouble need be had on that account, since it is plain that we must accept that root which would give $x=0$ when we set $m=0$. The results obtained from this equation by calculation have been compared with the direct results of experiment, and the agreement has been found to be quite satisfactory. Many other similar problems have also been worked out from theoretical principles and the results verified by direct observation, and by the introduction of the methods of the differential and integral calculus it has even been found to be possible to follow the course of such reactions from stage to stage, so that the composition of the solution can be known at every instant, and not merely for the state of final equilibrium.

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Allan D. Risteen.

SOLVAY, Ernest, Belgian manufacturer: b. Rabeck, near Brussels, 16 April 1838. He was educated at Liège and early engaged in the manufacture of chemicals. He developed the ammonia process for manufacturing soda, established it commercially, and after first manufacturing at Couillet, Belgium, which plant he established in 1863, he extended the industry throughout Europe and America. By 1913 he owned a practical monopoly of the production of the world's supply of soda. He has given liberally of his great fortune to educational and charitable purposes and while suffering material losses through the European War greatly assisted his countrymen during the German invasion. He served in the Belgian Senate in 1893–1900; founded the Ecole de Commerce and the Ecole des Sciences Politiques et Sociales, as well as international institutes of chemistry and sociology, and is president of the Bureau of the International Institute of Bibliography at Brussels. He is a grand officer of the Order of Leopold, honorary member of the Royal Institute of Great Britain and was awarded the Lavoisier medal of the Institute of France and the grand medal of the University of Paris.

SOLWAY FIRTH, sŏl'wā fėrth, Great Britain, an arm of the Irish Sea separating the county of Cumberland, England, from the southwestern part of Scotland. It extends nearly 40 miles inland, narrowing gradually from a breadth of 20 miles. Its upper part forms the estuary of the Esk. Large areas are left dry at low tide, while the high tide rushes in as a violent bore.

SOLYMAN I, El Kanouni (The Magnificent), emperor of Turkey, son of Selim I: b. 1493; d. Szigeth, Hungary, 1566. He succeeded his father in 1520, crushed a rebellion in Syria in 1521, concluded a treaty of peace with Venice and then inaugurated the first of a long series of wars against Europe. He captured Belgrade in 1521, Rhodes in 1522, defeated the Hungarians with fearful loss at Mohács in 1526 and mastered Buda in 1529. He then laid siege to Vienna, but met with disastrous defeat. He took Bagdad in 1534, and on condition of an enormous yearly tribute concluded a peace with Venice in 1539 and with Austria in 1547. He made successful war against Kurdistan, conquered Van and Tebriz and part of Georgia in 1548, but in the next year met with continued losses at the hands of Austria, and in 1552 he was defeated with enormous loss in the siege of Erlau. His wars with Persia in 1554–55 were disastrous as were also his Hungarian wars of 1558. He attempted to break Spain's naval power, but met with defeat at Malta in 1565, though he took the Isle of Chios in 1566. He was engaged in a war with Austria when he fell at the siege of Szigeth. His reign saw the zenith and the decline of Ottoman power. He remodeled the code of laws, introduced reforms in the judiciary and in taxation and erected mosques and public buildings which are marvels of Ottoman architecture. He was also a poet and a patron of literature and art. In addition to his own superior abilities he was aided by statesmen, generals and naval commanders of unquestionable greatness. His successes came principally in the early years of his reign and though he left his empire with greatly extended boundaries it had been much weakened by his long continued wars.

SOLYMAN II, Turkish emperor, son of Sultan Ibrahim: b. 1642; d. Constantinople, Turkey, 1691. He succeeded to the throne on the disposition of his brother, Mahomet IV, in 1687. His life had been spent in the seraglio in the study of the Koran and feeling his incapacity to reign he entrusted the administration of the government principally to his grand vizier, Kupruli Zadek Mustapha Pasha, the Virtuous. His reign saw the defeat of Turkish arms in Hungary and in Serbia, the grand vizier meeting death at the disastrous defeat of Selankemen two months after the death of his master.

SOMA, a sacred plant of India and an intoxicating drink prepared from it, the latter being a libation of great importance in the ancient religion of India. The draught is not only an offering to Indra, but in the form haoma is poured upon the ground, at the beginning of a meal, or at the reception of guests, as a drink-offering to the earth. Soma is also a lunar divinity, allied to Indra, the plant having been deified before the separation of the Indo-Iranians, on account of its moon-like swelling and color and because of the maddening effects of its juice. It is, moreover, identified with the Hindus' mythical tree of life that grew in paradise, the juice of which imparted immortality and which was guarded by spirits. The Rig-Veda refers to this in a hymn:

> "We've quaffed the soma bright
> And are immortal grown
> We've entered into light,
> And all the gods have known."

According to John Fiske, the soma is a plant, connected mythically with lightning. Although several plants have been called soma, it is generally supposed that *Sarcostemma brevistigma* is the plant indicated. It is a climbing plant, also called moon-plant, of the milk-weed family, with slender jointed stems and succulent pendulous branches, terminated by small umbel-like cymes of whitish fragrant blossoms. It has a milky juice. Soma is picked by moonlight, taken to a place of sacrifice and crushed between stones; the juice is then strained and allowed to ferment. It is then offered to the gods and afterward drunk by the priests.

SOMALILAND, sō-mä′lē-länd, Africa, a general name applied to the coast region to the southeast of Abyssinia and bordering on the Gulf of Aden and the Indian Ocean as far south as the equator. The region is divided between France, Great Britain and Italy. See French Somaliland; Italian Somaliland; British Empire.

SOMALILAND PROTECTORATE, a territory on the west coast of Africa under the protection of Great Britain, lying along the Gulf of Aden from about long. 43° to 49° E., and extending from about lat. 11° to 8° N. On the east and southeast it is bounded by Italian Somaliland, on the south and west by Abyssinia and on the northwest by French Somaliland. It has an area estimated at nearly 70,000 square miles, lacking in fertility largely on account of a need of natural irrigation. The surface is in great part mountainous. The climate is more healthful in the interior than along the coast where there is more humidity. Among the chief products are sheep, cattle, skins, ostrich feathers, myrrh and incense. The principal ports are Bulhar, Zeila and Berbera, connected by telegraph lines and having wireless telegraph stations. Berbera, the capital, pop. 30,000, has a good harbor and is in winter the scene of considerable commercial activity. The combined imports and exports are valued at about $2,500,000. The protectorate, created in 1884, is administered by a commissioner and commander-in-chief appointed by the colonial office since 1 April 1905. In 1894 the boundary between this protectorate and Italian Somaliland was defined. In the spring of 1903 an agitation in this region in favor of the Mad Mullah (q.v.) led to a considerable loss among the British troops and their concentration on the coast. Since 1912 a camel constabulary corps has been effective in checking intertribal fighting. The inhabitants are related to the Abyssinians and Gallas and on account of their nomadic habits there are no accurate statistics of population, which is estimated at about 300,000. Consult Drake-Brockman, R. E., 'British Somaliland' (London 1912); Hamilton, A., 'Somaliland' (London 1911); Swayne, H. G. C., 'Seventeen Trips through Somaliland' (London 1900).

SOMBRERETE, sōm-brā-rā′tē, Mexico, in the state of Zacatecas, 65 miles northwest of the town of that name, in a mountainous district (2,570 metres), rich in silver. Its mines are said to have once contained the richest veins ever known, but are now nearly exhausted. Pop. 11,954.

SOMBRERO (sōm-brā′rō) **ISLAND**, West Indies, a small rocky island of the Leeward Group, about midway between the Virgin Group and Anguilla, resembling in form the Mexican hat or sombrero, whence the name. Its staple products are sugar and molasses, besides pineapples and cocoa. It exported formerly large quantities of phosphate of lime, the deposits of which have been exhausted. Administratively it is attached to the Virgin Islands. The Board of Trade supports a lighthouse on the island.

SOMERS, Sir **George**, English navigator: b. Lyme Regis, Dorset, 1554; d. Bermuda Islands, 9 Nov. 1611. He took part in a number of voyages, notably in those of Sir Walter Raleigh, upon the Spanish seas, and in 1606 entered into organization of the London or South-Virginia Company for the colonization of the western continent and was afterward created admiral of the fleet bound for Virginia which sailed from Plymouth, 2 June 1609. His ship, the *Sea Venture*, was separated from the rest of the fleet by a hurricane when half way across the Atlantic, and on 25 July landed at the Bermuda Islands, which were immediately claimed by him as English possessions and named Virgineola and later the Somers Islands. They were afterward colonized from Virginia. Consult Neill, E. D., 'Virginia Company of London' (Albany, N. Y., 1869); Doyle, J. A., 'English Colonies in America' (New York 1882–1907); Lefroy, 'Historye of the Bermudaes or Summer Islands' (Hakluyt Society 1882).

SOMERS, John, Lord, English statesman: b. Worcester, 4 March 1652; d. London, 26 April 1716. He was graduated from Oxford and admitted to the bar in 1676. As a prominent member of the Whig or Country party he was active in the political life of the revolutionary period. He was chairman of the committee which drafted the Bill of Rights and was the defender of that bill in Parliament. He was engaged as counsel for the Seven Bishops in 1688 and occupied a number of important offices during the reigns of James II and William III, being Solicitor-General (1689); Attorney-General (1692); Lord Keeper (1693) and speaker of the House of Lords in the same year. In 1697 he became Lord Chancellor of England and was raised to the peerage. Papers for his impeachment were begun in 1700, when he was removed from the chancellorship. His valuable papers were collected and edited by Sir Walter Scott in 1809–15. Consult Maddock, Henry, 'An Account of the Life and Writings of Lord Chancellor Somers' (London 1812).

SOMERS, Richard, American naval officer: b. Egg Harbor, N. J., 1778; d. 4 Sept. 1804. He entered the navy in 1798 and was assigned to the frigate *United States*. In the war with Tripoli he was placed in command of the *Nautilus* and for gallant service rendered in that campaign was made commander. He was killed in a heroic attempt to destroy the Turkish fleet by blowing up his own ship, the *Intrepid*, in its midst.

SOMERS ISLANDS. See BERMUDA ISLANDS.

SOMERSET, LADY Henry (Isabel), English temperance reformer, daughter of the Earl of Somers: b. 1850. She was married to Lord Henry Somerset in 1873; is actively interested in various industrial institutions and local missions; founded the industrial farm colony for inebriate women at Duxhurst, Surrey, and established and conducted for 15 years a home for training workhouse children and a home for children from the Society for the Prevention of Cruelty to Children. She is president of the National British Women's Temperance Association and in 1889 was elected president of the World's Women's Christian Temperance Union. She is editor of the *Women's Signal* and has written 'Studies in Black and White'; 'Our Village Life' and 'Beauty and Ashes,' a book on reform for women. She has frequently visited and lectured in the United States.

SOMERSET, Ky., city and county-seat of Pulaski County, 68 miles south of Lexington, on the Cincinnati, New Orleans and Texas Pacific Railroad. There are railroad shops and manufactures of knit goods, lumber, spokes and staves. Pop. 4,491.

SOMERSET, Mass., town and village in Bristol County, on the Taunton River, 42 miles south of Boston, and on the New York, New Haven and Hartford Railroad. It has iron works and a stove manufacturing industry. Pop. 3,377.

SOMERSET (Ky.), **Engagement at.** In March 1863, Gen. John Pegram, with 1,550 cavalry and three guns, started from East Tennessee on an expedition into eastern Kentucky to seize beef cattle for the Confederate army. On 22 March he crossed to the north bank of the Cumberland River, by Stigall's Ferry, and making a forced march reached and attacked Danville, on the 24th, driving out Wolford's Union cavalry and pursuing them nearly to the Kentucky River. He then began to collect his cattle in the counties of Lincoln, Boyle and Garrard. On the 26th General Burnside ordered Generals Gillmore and Manson, who were north of the Kentucky River, to concentrate their forces and attack Pegram, then in the vicinity of Danville. Gillmore crossed the Kentucky River at Hickman's bridge on the 28th and drove Pegram across Dick's River, Pegram burning the bridges to check pursuit. On the same day Manson occupied Danville and moved to co-operate with Gillmore, who was following Pegram toward the Cumberland. Pegram had called in and concentrated his command, and falling back skirmishing, made a stand in a strong position on Dutton's Hill, three miles north of Somerset, in order to check the Union pursuit until he could get all his captured cattle across the river, six miles in his rear. Gillmore, with 1,250 mounted men and six guns, advanced on Pegram's position at daybreak of the 30th and drove his rear-guard back upon his main line, which he found strongly posted and resisting firmly. An effort by Pegram to turn Gillmore's right failed and Gillmore, dismounting his men and forming in line, the action began at noon by artillery firing on both sides, which was continued two hours, when Gillmore's men charged to within 30 yards of the Confederate line and it gave way from right to left and could not be rallied until near the town, when order was restored and another position taken and slight works thrown up, about three miles south of Somerset. As night was setting in, no attack was made on this position, Gillmore contenting himself with throwing a few shells and advancing his skirmishers. During the night Pegram recrossed the Cumberland at Stigall's Ferry with 537 of the 750 cattle he had collected. The Union loss in the engagement was about 30 killed and wounded. Pegram reports a loss during his raid of over 200 men. Consult 'Official Records' (Vol. XXIII).

SOMERSWORTH, N. H., city in Strafford County, on Salmon Falls River, 18 miles northwest of Manchester, on the Boston and Maine Railroad. There are manufactures of cotton goods, yarns, boots, shoes and boxes and also bleaching and dye works. The place was settled in 1729. Pop. 6,704.

SOMERVILLE, Alexander, Canadian journalist: b. Springfield, East Lothian, Scotland, 15 March 1811; d. Toronto, Canada, 17 June 1885. He enlisted in the Scots Grays at Birmingham on the eve of the Reform riots of 1832. He protested against the orders to the soldiers to rough sharpen their swords in expectations of a conflict with the rioters, and later, on another pretext, but in his opinion because of his former action, he was given 100 lashes. He obtained an inquiry, the principals in the affair were reprimanded and a Parliamentary discussion of army discipline followed with the result of a modification of certain harsh practices in the army. He served with the British Legion in Spain in 1835 and in 1837 he resigned from the army. In 1839 he was asked to lead an insurrection in Wales, but instead he set to work to prevent it. He was later engaged in journalism and in 1858 he removed to Canada, where he was for a time editor of the *Canadian Illustrated News* and he was a contributor to the *Spectator* and other periodicals. He died in extreme poverty, refusing to the last the assistance of his friends. Author of 'Autobiography of a Workingman' (1848); 'Financial Reform Catechism' (1849); 'The Conservation Science of Nations,' containing an account of his army experience (1860); 'A Narrative of the Fenian Invasion of Canada' (1860), etc.

SOMERVILLE, Mary Fairfax, English mathematician: b. Jedburgh, Scotland, 26 Dec. 1780; d. Naples, Italy, 29 Nov. 1872. She was the daughter of Admiral Fairfax and in 1804 was married to Samuel Grey (d. 1807). It was not, however, until after her 30th year and her marriage to her cousin, William Somerville, that she began to publish the results of her studies. In 1827 she began the translation of Laplace's 'Méchanique Céleste' and four years later popularized in England the great work of the astronomer under the title, ‘The Mechanism of the Heavens’ (1831). The book was immediately adopted by the English universities and brought her prominently before the scientific world. Her fame, however, did not rest upon this great undertaking alone. In 1834 she published ‘The Connection of the Physical Sciences,’ a work which was also widely read and in 1848 a treatise upon physical geography. The latter half of her life was spent in Italy, where she lived with her children after the death of her husband and where her efforts were devoted to the revision of her earlier books and the writing of her ‘Molecular and Microscopic Sciences’ (1869). The story of her life contained in an autobiographical account entitled ‘Personal Recollections of Mary Somerville,’ compiled and edited by her daughter, is a valuable history of her long and useful career.

SOMERVILLE, William, English poet: b. Edstone, Warwickshire, 1677; d. 19 July 1742. His most celebrated poem, ‘The Chase,’ an epic, written in blank verse and published in two volumes in 1734, made a place for him among the 18th century poets. He wrote also a burlesque of rural games entitled ‘Hobbinol’ (1740) and ‘Field Sports’ (1742). His poems with a biography are in the collections of Johnson and Chambers; a collective edition of his works appearing in 1801. ‘The Chase’ has been edited separately by G. Gilfillan (Edinburgh 1859).

SOMERVILLE, Mass., city in Middlesex County, on the Mystic River and on the Fitchburg and the Boston and Maine railroads. The Mystic separates the city from Chelsea on the east, Boston is on the southeast boundary and Cambridge on the southwest and west. Several steam railroads and electric lines connect the city with Boston, Cambridge, Chelsea, Newton and all the nearby towns and cities. It is largely a residential suburb of Boston and has many fine private and public dwellings. Somerville was settled in 1629 and was a part of Charleston until 1842 when it was set off as an independent town. In 1872 it was incorporated as a city. It is built on seven hills, all of which exist, although street grading has lowered some of them. In 1631 the first vessel built in Massachusetts was launched from Governor Winthrop's “Ten Hill” farm on the Mystic. On Quarry Hill, in the centre of one of the public parks, is an old building, once a powder-house, which was built in 1703. During the Revolutionary period several fortifications were built on the hills of Somerville. On Cobble Hill was General Putnam's fortress, another fortification was on Winter Hill, and the “citadel,” on Prospect Hill, was where, on 1 Jan. 1776, Washington raised the first colonial union flag. The city has a large amount of manufacturing interests, including slaughtering and meat-packing, cloth bleaching and dyeing, distilling and the manufacture of desks, pictures and frames and metal tubing. There are three public parks, a hospital, a home for the aged, in charge of the Little Sisters of the Poor, an insane asylum and a number of other charitable organizations. There are 31 churches and 28 school buildings. The educational institutions are English and Latin high schools, public and parish schools, several private business schools and a public library. In educational and industrial life Somerville is identified with Boston in many ways. The government of Somerville is vested in a mayor elected annually and a unicameral council. Pop. 77,236. Consult Samuels, ‘Somerville, Past and Present’ (Boston 1897), and Hurd, ‘History of Middlesex County’ (Philadelphia 1890).

SOMERVILLE, N. J., borough and county-seat of Somerset County, on the Raritan River and on the main line of the Central Railroad of New Jersey, 36 miles southwest of New York, 37 miles from Easton and 64 miles from Philadelphia. It is the trading centre for a large population, has a public library, hospital, two theatres, a courthouse, three banks, a high school, two public schools, eight churches and three weekly papers. It has manufactures of clothing, woolens, iron pipe, stoves, etc. The assessed valuation is $4,820,130. Electric railroads afford easy access to surrounding districts and to neighboring towns. Pop. 6,038.

SOMME, sŏm, France, (1) a river rising in the department of Aisne, seven miles northeast of Saint Quentin, flowing from southeast to northwest and falling into the English Channel. Its chief affluents are the Avre and Celle. It is 135 miles long and navigable from Amiens as far as Abbeville (q.v.) for vessels of 300 tons. It has canal connection with the Oise and the Scheldt. (2) The department of Somme in northern France has an area of 2,378 square miles. It consists of highly-cultivated and large, fertile plains and its highest point is at the southwest. Considerable land beyond the sand dunes of the coast has been reclaimed. The river Somme is the principal stream and on it is situated Amiens, the chief town. There are numerous industrial works — foundries, mills for textiles, paper, chemical, soap, lock, beet-sugar and other factories; important fisheries, etc. The exports include raw materials for manufacture, cider, timber, dyes, coal, horses and cattle. It is traversed by several railways. For the account of the engagements at the Somme during the European War, see WAR, EUROPEAN.

SOMMERVILLE, Maxwell, American archæologist: b. Philadelphia, 1 May 1829; d. Paris, France, 6 May 1904. Having spent many years in the collection of precious stones and historical gems, he became an authority upon glyptography and allied subjects and in 1894 was appointed professor of glyptology in the University of Pennsylvania. He is the author of ‘Engraved Gems’; ‘Sands of Sahara’ (1901); a monograph entitled ‘A Buddhist Temple’ (1900), and other works.

SOMNAMBULISM (sleep-walking, al[illegible] sometimes called noctambulism), pathologically considered, is caused by persistent, strong, unconscious wishes of the individual which cannot be inhibited but which must be carried out without conscious knowledge of the sleeper. The acts are usually clothed in symbolism which mostly veils their real meaning events from the conscious onlooker. It is analogous to the hypnotic or mesmeric state. It is similar to somniloquy or sleep-talking. Hippocrates, Aristotle and other ancient authors wrote upon it, and Galen is said to have been a victim to it. «The mind acts automatically under the dominance of some single idea. Sight, hearing and nearly all the avenues of sense are closed. The sleep-walker avoids obstacles and performs ordinary acts automatically, like an absent-minded man, which in reality he is.» His train of thought is in accordance with his single idea, continuous and logical. Portions of the brain usually involved in the physiological conditions peculiar to sleep seem to be exempt. The sleeper exerts powers which sleep usually annuls; the direction of voluntary movements in most trying circumstances is marvelous; he may be quite deaf to all ordinary auditory impressions; his eyes are usually insensible to light; they may be closed, partly closed or wide open; the pupils may be widely dilated, contracted or normal. The somnambulist has been known to walk from one part of the house to another, to climb steep roofs or walk along their ridges with ease, to solve intricate mathematical problems, to write letters or work upon pictures, to attempt murder or suicide, etc. He is roused from this state with difficulty, when he remembers nothing of what has occurred.

Somnambulism very frequently is found in certain highly neurotic families. This is probably due to imitation from parent to child. It often occurs at about the age of puberty where strong sexual wishes under strong repression, seek symbolic outlets. Usually the somnambulist should not be awakened until he is safely back in bed. To remedy the condition an adequate psychoanalysis should be carried out. It will tend not only to cure the condition, but also aid the individual in the neurosis which is almost an invariable accompaniment or in the making. Consult Jelliffe, 'Technique of Phychoanalysis' (1918).

SOMNATH, sŏm-nät', or **PATAN,** a town on a bay of the Arabian Sea, in Gujarat, 210 miles northwest of Bombay, almost enclosed by a massive wall, flanked by 38 towers. Magnificent ruins, of which the great temple may be seen at a long distance, mark its former wealth and prosperity. It was one of the original seats of Siva worship in India and has recently again become a favorite place of pilgrimage. The town contains many memorials of Krishna, but most of the inhabitants are Moslems, who have erected many mosques. The port of the town is Veráwal. Pop. 10,000.

SOMNUS, *in Greek mythology,* the god of sleep, son of Nox (Night) and twin brother of Mors (Death). He dwelt at the western extremity of the world, where the imagination of early poets placed all awful beings. Some of the poets describe him as a handsome youth, some as a dull and lazy god, whose dark abode no ray of Phœbus enters. He is sometimes represented with a wreath of poppies; sometimes with a horn, in which he carries dreams.

SON OF GIBOYER, The. Émile Augier, the upholder of bourgeois virtues upon the French stage, produced in 1862 his excellent satirical comedy of manners 'The Son of Giboyer' ('Le Fils de Giboyer'). A year earlier, in 'Les Effrontés,' he had introduced Giboyer as a hack writer ready to sell his pen to the highest bidder. In this sequel he made the character of his literary Bohemian more sympathetic, and, instead of attacking financial speculation and money-lust, assailed social corruption due to political influence and the attempts of the middle class to assume the titles of the nobility. Giboyer has been engaged to write a speech for Marechal, the spokesman of the aristocratic party, but no sooner has Marechal got his lesson by heart than the party leaders select another orator. Nothing daunted, Marechal now declaims a radical republican speech prepared by the same facile hand and reflecting Giboyer's true sentiments. The address creates a sensation, and Marechal, supposing it to be the composition of his young secretary, consents in gratitude to the latter's marriage with his daughter. It emerges, however, that the secretary is a natural son and that his father is the disreputable Giboyer, who has taken this means of assisting the youth in secret. Marechal is so far converted to democracy, however, that he interposes no objection to this match which he would earlier have disapproved. Even the Marquis d'Auberive, who has schemed to win pretty Fernande Marechal and her fortune for his nephew, abandons that ambition, and, blessing the lovers, offers to lend the protection of his name to the son of Giboyer. Although the comedy is old-fashioned in its easy conclusion and its reliance upon coincidences and asides, it sparkles with wit, and, in spite of much that is politically out of date, still lives, thanks to the universality of its satire. It has been translated into English by Benedict Papot (in *Drama,* November 1911) and receives full discussion in the French essays upon Augier by Morillot (1901) and Gaillard (1910).

le comte

FRANK W. CHANDLER.

SONATA, sō-nä'tạ, a piece of instrumental music intended to express various feelings in different passages, according to the variety of expression of which the instrument is susceptible. The sonata usually begins with an allegro or lively passage, followed by an andante or adagio; then a minuet with a trio, or a scherzo, and lastly a rondo or presto. Instead of the second, third or last division, variations are also made use of. The older forms of sonata, the word signifying an instrumental composition as distinguished from cantata, were written in two or more divisions and like the modern sonata constituted a complete musical piece — the passages connected by a common character — and exposition, development and restatement with a conclusion artistically worked out. The sonata was originally designed for one instrument only, principally for the violin; afterward for the piano almost exclusively. Subsequently sonatas or double sonatas were composed in which the piano or harpsichord is accompanied by other instruments; for instance, the violin or flute, horn, clarinet. The expression of the sonata is to be determined by the character of the instrument — a circumstance which modern composers have not sufficiently observed. In sonatas for several instruments the principal instrument is either only assisted (as is the case, for instance, with many sonatas for the pianoforte accompanied by the violincello), or the instruments alternate, so as to make the sonata a dialogue of instruments. An easy or short sonata is called sonatina. The most distinguished composers of sonatas are Haydn, Beethoven, Mozart, Mendelssohn, Clementi, Cramer, Hummel, Weber, Moscheles, Kalkbrenner, Field and Brahms.

SONDERBUND, zŏn'dĕr-boont, a league formed in 1846 by seven Roman Catholic cantons of Switzerland against the Federal Diet, which had decreed the expulsion of the Jesuits. The Diet voted the Sonderbund illegal 20 July 1847. Freiburg, their stronghold, was captured 13 November, Lucerne 24 November and the Sonderbund was dissolved.

SONG, a little poem intended to be sung; a lyric. The term is applied to either a short poetical or musical composition, but most frequently to both in union. As a poetical composition a song may be defined as a short poem divided into portions of returning measure and turning upon some single thought or feeling.

SONG OF BIRDS. The voice or song of birds results, like that of all higher vertebrates, from the vibration of vocal chords and of a column of air passing through the trachea or windpipe. In birds, however, the organ of voice is double and consists of an upper and a lower larynx or syrinx, the latter being the organ in which the voice or song is actually produced. The upper larynx is partly bony and partly cartilaginous, is situated at the glottis or opening of the trachea into the mouth and is of much simpler structure than the larynx of mammals, lacking the vocal chords. Except in the ostrich, American vultures and a few other birds, the syrinx is always developed. It presents great variety in size, form and disposition of parts. Its bony elements consist essentially of modifications of the lower rings of the trachea at the point of its bifurcation to form the bronchi and may be tracheal alone, or bronchial alone, or combine elements of both bronchi and trachea. The structure of the upper larynx, apart from experimental demonstration, proves that it is incompetent to produce the song-notes; and its chief office must, therefore, be that of modifying the song. The syrinx of the bird may be compared to «a reed prefixed to a tube.» Its characteristic structure is the semi-lunar membrane, which is attached to the upper part of the bony structure known as the transversale or pessulus, which bounds the lower end of the windpipe.

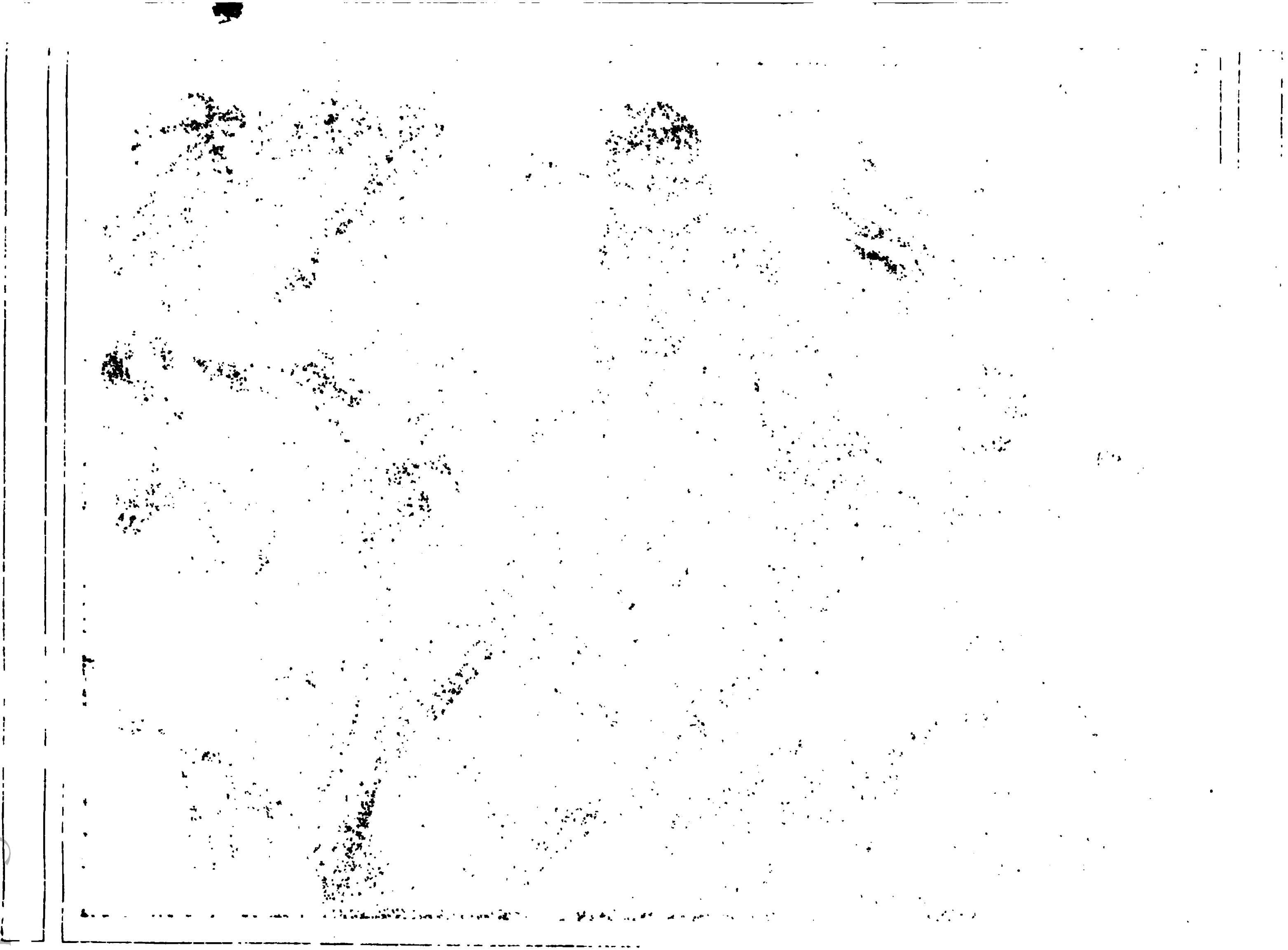
This semi-lunar membrane is in fact one of the vocal chords, but a pair of others are formed from folds of the mucous membrane projecting into the interior from the upper bronchial rings and bounding the pair of syringeal glottis laterally. The great distinction existing between the syrinx of singing and of non-singing birds lies in the mobility of these parts and the arrangement of the muscles. In the true singing birds the latter are numerous, distinct and so attached as to produce the tensions or laxness of the vocal chords upon which the variety of notes depends.

The song of birds, like the notes of most, if not of all, other animals, is in a minor key. Usually the range of song-notes may be comprised within a single octave, but of course these limits may be, and frequently are, greatly exceeded. The parrots, with a great range of voice and possessing great vocal capabilities, possess an inferior larynx, which differs from that of most other birds in being single in its nature. In the production of the peculiar shrill whistling of parrots the glottis is probably passive or silent — the column of air vibrating as in a flute, where a vibration is communicated by the air and traverses the elastic walls of the tube. Nearly all singing birds belong to the group *Oscines* and stand at the head of the class in perfection of general organization.

While much has been written in description of the songs of various species of birds and literature teems with tributes to the ability of feathered songsters and, although many songs have been reduced to words and others written in music, the philosophical side of the subject has been much neglected and a thoroughly comprehensive work is still a desideratum. One fact stands out very clearly, namely, that the vocal efforts of birds bear a close relation to sexual excitement. With many birds true song is confined to the period of mating and incubation and is replaced by the ordinary calls of alarm, etc., very soon after the young have hatched. In almost all it reaches its highest expression during that period and its effect is then heightened by various accompaniments of gesture, peculiar modes of flight, etc. Among true song-birds great vocal powers are almost confined to the males and are generally supposed to be the expression of greater vitality or to have resulted through selection by the females for their partners of those most gifted. A view which is gaining ground among zoologists is that the distinctive songs of birds are mimetic in origin and some consider that bird language, like human language, is not hereditary, but is learned anew from their parents by the young of each generation. Given an original exclamatory power of expression this has been given direction and augmented by the imitation of the various sounds of inanimate and animate nature, by which various species of birds were surrounded in their particular environment, just as the same elemental influences have been invoked to explain the origin of human language. In sexual selection, in the pleasure derived by a bird from its own music and in the needs for fuller power of expression are supposed to lie the forces effective in its further development.

Besides general works on ornithology, in which are included detailed descriptions of the songs of particular birds, consult Darwin, ‹The Descent of Man› (Vol. II, New York 1871), and ‹Expression of the Emotions› (New York 1873); Witchell, ‹Evolution of Bird Song› (New York 1896); Rhoads, ‹American Naturalist› (1899); Jones, ‹Songs of the Warblers› (Oberlin 1900); Burroughs, *Century Magazine* (1898–99); ‹Music of the Wild› (1910).

SONG TO DAVID, a notable lyrical poem, in 86 stanzas of six lines each, written by Christopher Smart (q.v.), apparently in lucid intervals during his mild madness and published shortly afterward in 1763. It was comparatively neglected in its day, but since its resuscitation in 1819 it has been highly praised, and it caused Browning to introduce Smart into his «Parleyings.» The tradition that it



1. Nightingale. 2 Robin redbreast 3 Blackcap. 4 [illegible]
11 [illegible] 12 [illegible]

[illegible] contrasts, [illegible] much, [illegible] the [illegible]

[illegible] the structure of the [illegible], [illegible] experimental [illegible] proves that it is [illegible] to [illegible] and [illegible], therefore, be [illegible] of modifying the song. The syrinx of the [illegible] may be compared to [illegible] reed [illegible] fixed to a [illegible]. Its characteristic structure is the semilunar membrane, which is attached to the upper part of the bony [illegible] known as the transverse or pessulus, which bounds the lower end of the trachea.

This semilunar membrane is in fact one of the vocal chords, but a pair of others are formed from folds of the mucous membrane projecting into the interior from the upper bronchial rings and bounding the [illegible] glottis laterally. The great distinction existing between the syrinx of singing and of non-singing birds lies in the number of these parts and the arrangement of the muscles. In the true singing birds the latter are numerous, distinct and so attached as to produce [illegible] tensions or laxness of the vocal chords upon which the variety of notes depends.

The song of birds, as the notes of most, if not all, other animals, [illegible] a minor key. [illegible] the range of [illegible] may be compassed within a single octave, [illegible] these limits may be, and frequently are, [illegible]

[illegible] peculiar [illegible] is produced [illegible] of air [illegible] is commanded [illegible] of [illegible] birds belong [illegible] the height [illegible] organization. [illegible] in descriptions [illegible] species of birds [illegible] to the ability [illegible] although many [illegible] and others [illegible] of the song [illegible] and a thoroughly [illegible] clearly, namely, that [illegible] bear a close relation [illegible]. With most birds true song [illegible] the period of mating and then [illegible] is replaced by the ordinary calls [illegible] soon after the young have [illegible] it reaches its highest [illegible] period and its effect is the [illegible] accompaniments of [illegible] flight, etc. Among [illegible] vocal powers are also [illegible] and are generally [illegible] expression of greater vitality [illegible] through selection by [illegible] most gifted [illegible] ground among zoologists [illegible] song of birds [illegible] some consider that [illegible] language, is not hereditary [illegible] from their parents [illegible] each generation. Given [illegible] power of expression this has been given direction and augmented by the imitation of the various sounds of inanimate and animate nature, by which various species of birds were surrounded in their particular environment, just as the [illegible] have been [illegible] the [illegible] in the [illegible] derived by a bird from its own music [illegible] the needs for fuller power of expression are supposed to be the forces effective in its [illegible] development.

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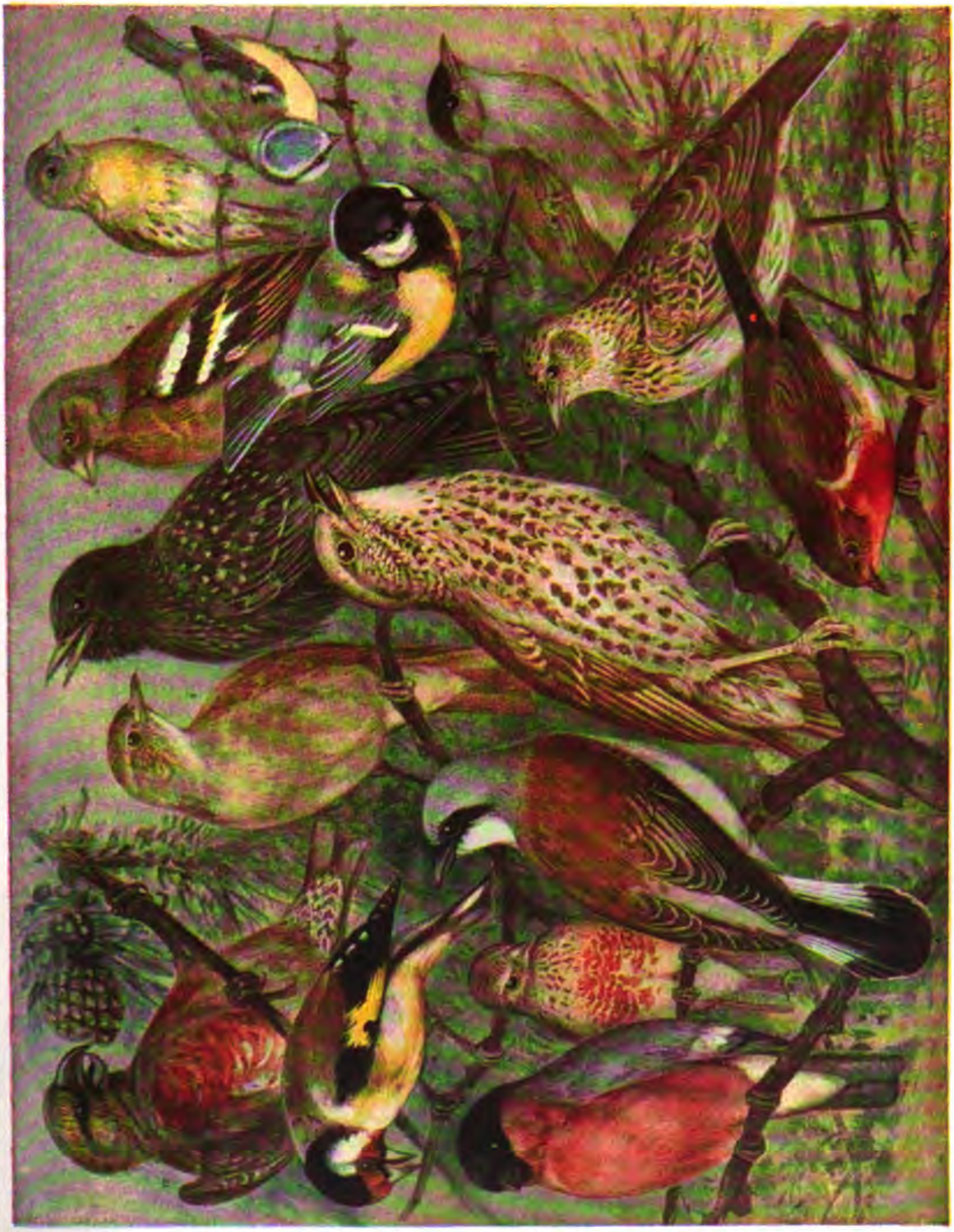
SONG BIRDS



1. Nightingale. 2. Robin Redbreast. 3 Blackcap. 4 Shrike. 5. Song Thrush. 6. Starling. 7. Chaffinch. 8. Siskin 9. Goldfinch. 10. Linnet.
11. Bullfinch. 12. Grossbill. 13. Skylark. 14. Greater Titmouse. 15. Blue Titmouse.

was written in charcoal on the walls and scratched with a key on the wainscot of its author's cell can contain but a nucleus of truth. That it is one of the noblest apostrophic poems of the language, full of Smart's piety, to which Dr. Johnson paid tribute, steeped in the sublimity of the Scriptural style and an extraordinary phenomenon both in the poet's works and in his conventional century is scarcely to-day subject for dispute. Some of the stanzas have a swift carrying or snatching power that makes Browning's reference to Keats and Milton seem a bit awry. Smart is himself, whether or not he was beside himself when he wrote his song to the «servant of God's holiest charge.» And he was himself in a sense little perceived by his critics. There are poetic, especially lyrical, elements in his other works that make the 'Song to David' a little less inexplicable as the production of «Kit» Smart than many have found it to be. There is, for example, a stanza in 'The Judgment of Midas,' which, with the change of «Jove» to «God,» would fit into the 'Song' in such a way that few readers would notice the intrusion. This reminds one of what is practically the only serious fault to be discovered in the poem — one not surprising when we consider Smart's mental condition — that its order of evolution is not always clear and that it might have been made longer or shorter without obvious loss. A convenient source for the text is G. W. Cooke's 'Guide-Book to the . . . Works of Robert Browning' (1901, pp. 87–98).

William P. Trent.

SONG OF HIAWATHA, The. 'The Song of Hiawatha,' which Longfellow published in 1855, is the most notable of the many responses to the demand — very strong during the first half of the 19th century — that the myths and legends of the aborigines be made into a truly American poem. Characteristically, he took his measure from a European epic, the Finnish 'Kalevala,' but the substance was from actual Indian traditions as Longfellow found them in such writers as Catlin, Heckewelder and especially Schoolcraft, whose 'Algic Researches' (1839) contains an interesting prose version of much of Longfellow's material. The scene of the poem is the southern shore of Lake Superior, among the Ojibways. The action concerns itself with the life of a famous legendary prophet called Manabozho by the Ojibways, and by the Iroquois, Hiawatha («he makes rivers»), who was said to have taught his people the beneficent arts of peace. Such a personage was of course more congenial to Longfellow than a mere fighter would have been. Hiawatha, though strong and valiant, fights only against the dangerous forces of nature. He clears the river channels, finds out how to cultivate maize, invents picture-writing; he is a gentleman and a true lover. Longfellow therefore had good reasons for selecting the gentler elements of Indian life and thought for his narrative, and it is partly beside the mark to say that 'Hiawatha' lacks its proper measure of savagery. Realistic its setting and personages are not, but the naïve Indian legends, appealing in their barest form, have been kept fresh by Longfellow's tender sympathy and clear and cheerful, though somewhat facile, style. Fenimore Cooper had given the Indian once for all his reputation as a crafty warrior. Longfellow added primitive goodness and religion to the perennial attributes of the Indian of romance.

Carl Van Doren.

SONG OF MYSELF. The poem in which the American author, Walt Whitman, chose to give an account of himself and his theory of poetic art. The substance of the poem forms, in a remarkable way, Whitman's *apologia,* and to it everyone must go who wishes to formulate anything like a correct estimate of the man and of his literary aims. It was first published in 1855, without a title; in 1856 as 'Walt Whitman, an American'; as 'Walt Whitman' in 1860, and until 1881, when the present title was adopted.

In its final form — for like everything of the author's it was carefully revised — the 'Song of Myself' consists of some 52 divisions of unequal length, and of no close or formal connection between parts, the unity of the work resulting from the fact that every part reveals some point of view, some half-realized emotion, some reflection or some vision of the writer. One is tempted to say of it by way of criticism that it is Walt Whitmanish through and through. It reveals to some degree everyone of Whitman's characteristics. The poem shifts at irregular intervals and in surprising ways from the cheapest slang to passages of rare poetic beauty. «I celebrate myself,» says the poet at the outset; «I loaf and invite my soul; I lean and loaf at my ease, observing a spear of summer grass.» The contemplation of the grass awakens Whitman's wonder, and forthwith he sets out on a contemplative journey that takes in the whole round of creation, every part and feature of which he pronounces good: «rich, apple-blossom'd earth,» he exultingly cries, «Smile, for your lover comes.» He tells us that as a poet he is only a mouthpiece; his thoughts «are the thoughts of all men in all ages and lands — they are not original.» «If,» he continues, «they are not yours as much as mine, they are nothing or next to nothing.» In consequence, he feels that through him there speak «many long dumb voices,» «many forbidden voices,» «voices veiled,» «voices indecent.» At this point we begin to realize what Whitman was actually trying to do; and in the light of this *apologia* we come to understand that he is far more than the merely «indecent» poet that so many people would have us believe him to be. It takes a great poet to be the mouthpiece of all. Whitman may not have been great enough to compass the task fully, but his efforts are not to be made light of. Whatever else we may do, we must reckon with him. We shall not reckon with him aright until we have first got thoroughly at the heart of this 'Song of Myself.' To be sure there may be in it much that is self-contradictory; we must remember that Whitman is «afoot with his vision.» Now and then, from his mountain heights, he strikes out such a great psalm as that «Immense have been the preparations for me,» which comes to his lips when he turns on the «apex of the apices of the stairs» and looks past the phantoms which «rise after rise» bow behind him until he sees «afar down the huge first Nothing» from which he took his origin.

There is just one thing to do with the 'Song of Myself,' and that is to read it. It cannot be summarized; it cannot be paraphrased. It must be taken as it is. When we have said that it breathes in every line «the wild joys of living,» the songs of a man who has looked upon life in all its phases and has found it good, the spirit of a man who has faith in the Power behind the universe, we have said all that we can. «I am not a bit tamed,» writes the poet in conclusion; «I am untranslatable; I sound my barbaric yawp over the roofs of the world . . . I stop somewhere, waiting for you.» Those who are going to read Whitman for the first should begin with this poem.

WALDO H. DUNN.

SONG OF SOLOMON. See CANTICLES.

SONG-SPARROW, a well-known sparrow (*Melospiza fasciata*), found in some one or other of its numerous races in all parts of North America except in the extreme north and south on the eastern side. The song-sparrow may be readily recognized by its thickly streaked plumage, brown above, ashy below, with the brown, black-centred streaks coalescing on the breast into a conspicuous spot. In most parts of the East song-sparrows remain throughout the year, but there is nevertheless a distinct north and south movement, the winter birds of any given locality being visitors from the North. In New England and most parts of the Middle States they are more plentiful in summer than in winter. During the latter season they associate more or less with flocks of fox-sparrows, white-throated sparrows and other species which frequent thickets along water-courses, but are much less gregarious than they. Their food consists of seeds of various kinds and in summer and autumn of insects and berries. They are chiefly birds of the ground and bushes and are never seen in the high tree-tops. Few birds surpass the song-sparrow in the real melody of their simple song, and few birds require so little of sunshine to start the joyous outburst even in midwinter. They sing in every month of the year, but most persistently and sweetly during the breeding season. The nest, which is built on the ground or in a low bush or evergreen, is a bulky structure of grass, leaves, etc., lined with fine grasses or horse-hair, receives four to five greenish white eggs varied endlessly in the character of the spots and blotches of browns and lavender. Usually two or three broods are raised each season. Other eastern species of the same genus are the Lincoln's sparrow (*M. lincolnii*) and the swamp-sparrow (*M. georgiana*), while, besides the numerous varieties of the song-sparrow in the West and Southwest, two distinct species (*M. insignis* and *M. cinerea*) occur in Alaska.

SONG-THRUSH, or **MAVIS.** In the United States the wood thrush is most conspicuous for its song. The thrush of Great Britain is also called song-thrush, while in Scotland it is known as «mavis.» Song-thrushes are common throughout the temperate zone in Europe, resembling the American robin in their habits. The eggs are blue, spotted with brown. The male is dark brown, with golden brown tints in its wings. The throat is buff and the underparts yellowish white, flecked with brown.

SONGS OF INNOCENCE AND OF EXPERIENCE. William Blake's 'Songs of Innocence' and 'Songs of Experience' were originally published as separate volumes, with both text and illustrations beautifully engraved after Blake's special method of relief-etching, in 1789 and 1794 respectively. They were republished together about 1794 under the title of 'Songs of Innocence and of Experience, Showing Contrary States of the Human Soul.' The contemporary sale of the somewhat expensive volumes was very small.

The lyrics in the collection are full of the symbolism which characterizes all of Blake's writings, but they differ from most of his works in their intelligibility and in the more universal character of their appeal. The 'Songs of Innocence' represent the soul untouched by the experience of evil. To Blake the naive and spontaneous consciousness of childhood was the ideal condition of human nature. Mature experience brings with it a separation of the spirit from the quickening and joy-giving contact with the divine sources of its true being. In his mystical philosophy all things are a single essence and of that escence the primary attribute is love.

"For Mercy, Pity, Peace, and Love,
Is God our Father dear;
And Mercy, Pity, Peace, and Love
Is man, his child and care."

Hence life, as seen in the 'Songs of Innocence,' is a continuous manifestation of sympathy and love in a world of pure joy, where envy, hatred and the consciousness of wrong have no place. Throughout this group the lamb and the child are symbols of innocent happiness; the shepherd, the nurse, the mother, the angels are the embodiments of all-enfolding love. Directly opposite is the atmosphere of the 'Songs of Experience.' The two sets of poems are full of correspondences, but in each lyric of the latter group the paradise of innocence is represented as blighted by the touch of evil. The idea is symbolically expressed in «The Sick Rose,» where «the invisible worm,» which cankers the bud, is reason, law, experience — the death of happiness and instinctive love. The two sorts of love, one spontaneous and unselfish, the other reasoned and calculating, are contrasted in «The Cloud and the Pebble.» The failing sense of communion with the divine which comes with the mature consciousness is expressed in the last stanza of «The Angel»:

"Soon my Angel came again;
I was armed, he came in vain,
For the time of youth was fled
And grey hairs were on my head."

In his emphasis on intuition and emotion and in his exaltation of the child as the true type of a pure humanity, Blake falls in with the cult of the primary instincts of human nature by the followers of Rousseau and anticipates doctrines familiar in the poetry of Wordsworth. As a poet he enjoys a more nearly unique position. Sometimes prosaically didactic, more often wayward and perverse, Blake at times shows himself a lyric genius of exceptional originality and power. The term «marvelous» best describes the effect of such a poem as «The Tiger,» with its burning imagery and the on-rushing beat of its rhythm.

Marvelous, too, is the poignancy of «The Sick Rose» and «Ah! Sunflower, Weary of Time.» But the more characteristic note is one of tender simplicity, in such pieces as the «Introduction» to 'Songs of Innocence' and «The Lamb,» lyrics which have endeared Blake to all lovers of the poetry of childhood. The most convenient edition and the best critical memoir are to be found in Rossetti, W. M., 'The Poetical Works of William Blake' (Bohn Library). Consult also Symons, Arthur, 'William Blake' (1907), and the essay by Yeats, W. B., in 'Ideas of Good and Evil.' Bibliography in Cambridge 'History of English Literature' (Vol. XI).

JAMES H. HANFORD.

SONNECK, Oscar George Theodore, American musician, librarian and scholar: b. Jersey City, N. J., 6 Oct. 1873. He was educated at the universities of Heidelberg and Munich and at the Sondershausen Conservatory, later studying piano under Kwast and instrumentation under Knorr at Frankfort. He was for a time engaged in research in Italy but in 1899 returned to the United States. He was appointed chief of the division of music at the library of Congress in 1902, which department under his direction has become one of the largest musical libraries in the world. His researches in the history of American music have proved highly valuable. From 1915 he also edited the *Musical Quarterly*. Author of 'Classification of Music and the Literature of Music' (1904); 'Bibliography of Early Secular American Music' (1905); 'Early Concert Life in America' (1907); 'Catalogue of the Dramatic Music in the Library of Congress' (1908); 'The Star Spangled Banner' (1914); 'Early Opera in America' (1915); 'Suum cuique: Essays in Music' (1916), etc. He is also known as a composer of music.

SONNENSCHEIN, William Swan, English publisher: b. London, 5 May 1855. He was educated at University College, London, and began the study of medicine. In 1878 he established a publishing business which since 1895 has been conducted as a limited company, under the name of Swan, Sonnenschein and Company, of which he is chairman. He is also joint managing director of George Routledge and Sons, Limited. He has published 'The Best Books' (1887; 5th impression, 1901), a classified dictionary of about 50,000 of the best available books, and 'A Reader's Guide to Contemporary Literature' (1901), a supplement to the foregoing.

SONNET, *in poetics:* (1) A short poem, song or ballad. (2) Specifically, a short poem of prescribed form restricted to 14 verses arranged according to a fixed disposition. The word came from the Italian *sonetto,* probably derived from the Old French and Provençal *sonet,* a diminutive of *son,* which was in turn obtained from the Latin *sonus,* a sound or musical air. That the sonnet originated in Italy seems now definitely settled, but the manner of its origin remains an object of discussion. D'Ancona ('Poesia Popolare,' 1878) as the result of his investigations, believes that it was developed by a combination of two popular stanzas, the *strambotto,* of eight verses, with a riming-scheme *a b a b,* etc., and the *rispetto,* of six verses, with a scheme *c d c d,* etc. Cesareo, a later student ('La Poesia Siciliana,' 1894), modifies this view by making the combination one of *strambotti,* the one of eight verses, the other of six. The beginnings of the sonnet appear to date from the early 13th century. It quickly attained popularity, and various writers attempted elaborations and other changes. Septisyllabic verses were inserted to vary the hendecasyllabic measure, the length of the sonnet being sometimes thus doubled; or verses might be appended, constituting a *coda* or *cauda.* The simpler arrangement, however, prevailed. At the same time, as to the riming-scheme, in the octave, or portion of eight verses, the arrangement *a b b a a b b a* replaced that of *a b a b,* etc., while in the sestet, or portion of six verses, it might be *c d e c d e,* as well as *c d c d,* etc. The sonnet was firmly established on this new basis by Francesco Petrarca (Petrarch), and this form has since been generally known as the Petrarchan. Boscan introduced the sonnet into Spain; Camõens, into Portugal. In France, Marot was the first great maker of sonnets, though it is maintained that this form of poetics was first introduced by Mellin de Saint-Gelais. The poets of the Pléiade were its chief exponents. In Germany they first appeared in the 16th century, but received their greatest impetus during the Romantic period, A. W. Schlegel, Goethe, Heyse, Eichendorf and Redwitz being among the sonnet-makers. Wyatt (q.v.) and Surrey (q.v.) introduced the sonnet into English literature in the middle of the 16th century. In England a modification was employed by Shakespeare, Drayton and others. This modification has been called the simple stanza in contradistinction to the Petrarchan, or compound stanza. The type is *a b a b a b a b a b a b c c.* The Sheakespearean is distinguished in another way from the Petrarchan; for while the latter formally separated the octave and sestet, the former could not properly be said to have such a division — the arrangement being really three quatrains succeeded by a couplet — and the sense therefore might be continuous. In English the decasyllabic measure is the one generally used, although the octosyllabic is found. The Shakespearean type has not been to any extent used. the Petrarchan being regarded as the orthodox or standard. Deviations, as in the case of S. T. Coleridge, (q.v.) are called irregular sonnets or quatorzains; or, in Charles Lamb's whimsical coinage, «fourteeners.» Critics point out what is called the Miltonic structure in the Petrarchan sonnet, Milton blending octave and sestet so that there is no pause in rhythm or thought. This modification has by Sharp ('Sonnets of this Century,' 1886) and others been distinguished as a separate type. The sonnet should be the vehicle of expression of one thought or idea, and the compactness and unity of the verse-form of course favor this. Hence the sonnet has been much used for what Watts-Dunton has styled «poetized didactics.» The difficulties offered by the sonnet are considerable. The sense of mere ingenuity, except in the case of such facetiæ as Milton's 'On the Detraction Which Followed Upon My Writing Certain Treatises' (XI), is necessarily to be avoided. Even a partial list of sonnet-writers in English would require much space. A collection of British examples, from the Earl of Surrey to Alexander Smith, was made by J. Dennis (1873). American literature has in the sonnets of Longfellow (q.v.), notably the series on the 'Divine Comedy,' many of the finest specimens in the language.

Bibliography.—Besides the above-mentioned works De Veyrière, 'Monographie du Sonnet' (1869–70); Tomlinson, 'The Sonnet' (1874); Welti, 'Geschichte des Sonettes in der deutschen Dichtung' (1884); Gummere, 'Handbook of Poetics' (1885); Main, 'A Treasury of English Sonnets' (1880); Corson, 'A Primer of English Verse' (1892); Noble, 'The Sonnet in England' (1896); Vaganay, 'Le Sonnet en Italie et en France au XVIème Siècle' (1902); Herrick, 'A Century of Sonnets' (1902); Sharp, W., 'Sonnets of this Century with a Critical Introduction' (1887).

SONNETS FROM THE PORTUGUESE. 'Sonnets from the Portuguese' is the title of a sequence of 44 sonnets on the Italian model, written by Elizabeth Barrett Browning — Elizabeth Barrett, as she then was known — to her fellow-poet and future husband, Robert Browning. Aside from their nobility of thought and diction, they are noteworthy for their bearing upon a great love story that is unique in literary history.

Because she falsely believed herself a hopeless invalid and because of the certainty of parental objection, Miss Barrett had rejected Browning's offers of marriage until his ardor overcame her protests. The sonnets, written by her during their secret betrothal, reveal her doubts, her feeling of unworthiness, her gradual yielding, her exaltation in a great and wonderful love. It was several months after their romantic marriage that she placed the manuscript in her husband's hands. Browning, who declared, "I dared not reserve to myself the finest sonnets written in any language since Shakespeare's," with difficulty persuaded her to give them to the world. The name, 'Sonnets From the Portuguese,' invented by him to veil the true origin, was adopted partly because it suggested the love of Catarina and the Portuguese poet, Camöens, and partly because "my little Portuguese" was a pet name that Browning gave his wife. While others have not gone so far in their praise as Browning in his pardonable enthusiasm, the high rank of the sonnets is beyond question; and Saintsbury has, in fact, said of the fourteenth of the sequence, that it "does not fall far short of Shakespeare's."

Arthur Guiterman.

SONNETS FROM VENICE. The common consent of critics and general readers ranks Platen's 'Sonnette aus Venedig' (1825) as the most perfect of their kind in German literature not alone for their faultless construction and musical cadence but also for their marvelous reproduction of all the moods inspired by the magic beauty of Venice with its ever-present historical monuments and by a melancholy sympathy for its fallen greatness.

To the original 12 sonnets Platen added five variants, a small number to be chosen from the voluminous writings of the most aristocratic and faultless master of German verse as his contribution to world literature. For Platen the City of Lagoons had a miraculous, mysterious, awesome beauty in its "labyrinth of bridges and canals" from which he took a regretful leave after two months of delight, with feelings akin to those of banished Ovid longing for Rome. The "Neptunian city where divine honor is paid to winged lions by a glad-hearted people of charming idlers, everywhere the monument of fallen greatness, whose horses, captured in the sack of Constantinople, were humbled by the Corsican's bridle," revealed to Platen a wealth of power and gentleness even in its cold unyielding marble where "art grew from the sea like a gorgeous tulip." Von Klenze claims Platen as the "first visitor to be keenly alive to the charm of her Giovanni Bellini; to show sympathetic comprehension of the church of SS. Giovanni e Paolo and its treasures." But Platen's "first love in Venice," Bellini, gradually found a victorious rival in Titian, whose 'Ascension of Mary,' 'Peter the Martyr,' and especially 'John the Baptist,' incorporated for him the spirit of Venice.

Carl E. Eggert.

SONNINO, sŏn'nē-nọ', **Baron Sidney Constantino,** Italian statesman: b. Pisa, 11 March 1847. His father was a wealthy Tuscan of Jewish descent and his mother, *née* Georgina Terry, was English. He studied law at the University of Pisa and took his degree in 1865. His legal career was short, for he returned his first brief on the ground that the client was entirely in the wrong and the case unworthy of defense. From 1867 to 1871 he served in the diplomatic corps at the Italian legations in Berlin, Vienna, Paris and Madrid. Returning to private life at the close of the Franco-German War, his financial independence enabled him to devote himself to economic and scientific studies. In the early 70's he began an exhaustive inquiry into the economic conditions of Sicily in co-operation with Baron Franchetti. The result of their labor was published in two volumes in 1877 under the title of 'The Peasants of Sicily,' a work which attracted considerable attention. Extending his investigations to the southern provinces of the peninsula, Baron Sonnino, still a private citizen, probed the serious conditions of woman and child labor, emigration and industrial backwardness. Many valuable reforms were inaugurated at his instigation. Turning to journalism, he founded the weekly *La Rassegna Settimanale* in 1878, editing it for several years. In 1882 he converted the review into a daily paper, *La Rassegna,* which flourished for many years. He also founded the important *Giornale d Italia,* of which he is believed to be the present proprietor. Elected a deputy to Parliament in 1880, he was soon recognized as an authority on finance, agriculture and foreign affairs. In view of what occurred over 30 years later, it is interesting to recall that in 1883 Baron Sonnino complained of the subordinate position of Italy in the Triple Alliance, and advocated a better understanding with Great Britain. He even hinted that Germany and Austria were playing a double game. His precise criticisms of the then prevailing chaos in national finance led to his appointment as Under Secretary for the Treasury in the second Crispi administration. In 1896 he became Finance Minister, in which capacity he laid the foundations of Italy's economic prosperity. He abolished corruption and secret subsidies, purified the administration and became leader of the constitutional party. He was twice Premier, in 1906 and 1909, for only a short time on each occasion. Seeking neither popularity nor self-advertisement, he was unable to withstand the political machinations of Giolitti. On the resignation of the latter in March 1914 Signor Salandra became Premier, and when San Giuliano, the foreign Minister, died in October of that year, Baron Sonnino was called to the Foreign Office. The story of his remarkable diplomatic duel with Count Berchtold, Baron Burian and Prince Bülow between December 1914 and May 1915 is related under Italy and the War (q.v.). With undeviating tenacity of purpose Sonnino resisted the promises, threats and blandishments of the central powers; he broke up the Triple Alliance, restored Italy's liberty of action and ranged her on the side of the Allies at one of the most critical moments of history.

SONOMETER. See Monochord.

SONORA, sō-nō'rä, Mexico; except Chihuahua, the largest state of that republic; bounded on the north by Arizona and New Mexico (United States), on the east by Chihuahua, on the southeast by Sinaloa, on the southwest and west by the Gulf of California, and on the northwest by the territory of Lower California. Area, 76,900 square miles. The mountains of the eastern part of the state are the Sierra Madre and a number of secondary chains. Principal rivers are the Altar (also called Asunción or San Ignacio), Yaqui, Mayo, Sonora and Mátope. The chief port is Guaymas. In the mountains the climate is cool and occasionally cold; the flat western districts and the low, arid coast are hot, the thermometer sometimes recording 119° F. at Guaymas. In 'Mexico: a Geographical Sketch' (Bureau American Republics, 1900), «rain falling from a cloudless and serene sky,» is mentioned as a «peculiarity» of the Sonora coast. The production of minerals in this state is especially noteworthy, there being extensive annual exports of silver, lead, gold, copper, coal, antimony, iron, cinnabar and graphite. The soil is fertile, but in many sections requires, and at present lacks, irrigation. The chief products are cereals, tobacco, cotton, sugarcane and fruits. Imports are machinery and agricultural and mining implements, material for clothing (cotton, linen, wool and silk), wines and liquors, hardware and arms and ammunition. Some of the pearls found in the Gulf of California are sent to European markets; otherwise all the foreign trade is with the adjacent States and Territories of the American Union. The only railway in the state runs from Guaymas to Nogales. The latter, being on the boundary-line between Sonora and the United States, is divided by a street into the two towns of Nogales, Mexico, and Nogales, Ariz. The capital of the state is Hermosillo (pop. 14,574), chief town of the rich mining district also called Hermosillo. Here are located the government palace, mint, cathedral and library. Pope Pius VI in 1779–81 created a bishopric including Sonora, Sinaloa and the two Californias. In 1842 Gándara, an ambitious provincial leader, made Sonora the theatre of a civil war. During the war with France (1862–67), interesting campaigns were conducted in the state. Hermosillo, captured 4 May 1866 by the republicans, was retaken by the imperialists; but the French forces were withdrawn from Guaymas in September of the same year. Less than a decade afterward occurred the Yaqui War (1885–86). Total population of the state, 275,107.

SONS OF THE AMERICAN REVOLUTION, a patriotic American society, organized in New York in April 1889. Its objects are to perpetuate the memory and spirit of the men who achieved American independence by the encouragement of historical research in relation to the Revolution; the preservation of documents, records and relics, and to foster true American patriotism. There are branches of the society in various States. The total membership of the society is about 12,500.

SONS OF LIBERTY, an American patriotic association of the colonists called into existence by Lord Grenville's Stamp Act. They combined to throw off the allegiance to Great Britain and make America independent. The association began in New York and Connecticut. The Sons of Liberty joined the Society of Tammany early in the 19th century. See Tammany Society.

SONS OF THE REVOLUTION, an American patriotic society organized in New York in 1875 by John Austin Stevens and others. The practical work designed for the society includes the collection and preservation of manuscripts, records and other documents relating to the War of the Revolution. There are branch societies in various States, including California. The membership in 1910 was 7,560.

SONS OF TEMPERANCE. See Temperance, Sons of.

SONS OF VETERANS, an American patriotic organization, founded in 1879. Those eligible to membership are all male descendants, not less than 18 years old, of all soldiers, sailors or marines who served with the Union forces in the Civil War. The insignia consists of a bronze bar bearing the words 'Filii Veteranorum,' from which hangs a red, white and blue ribbon to which is attached a medallion with the monogram S. V. The background is a wreath over crossed cannons. The monogram is surmounted by a spread eagle. Membership about 60,000. The Daughters of Veterans is a similar organization.

SONTAG, Henrietta, German opera singer: b. Coblenz, Prussia, 13 May 1805; d. Mexico, 17 June 1854. She was a favorite of the German operatic stage in her girlhood and later one of the most celebrated singers of Europe. In 1830 she was married to an Italian nobleman and withdrew from public life and to comparative retirement from the stage. In 1852 her husband's fortunes having been greatly altered by political changes, she made a tour through the United States and won fresh laurels by her voice and dramatic talent, but succumbed to an attack of cholera while singing in Mexico. Consult Berger, 'Berühmte Frauen' (Berlin 1904).

SOORD, Alfred Usher, English painter: b. 1867; d. Bushey, England, 9 Aug. 1915. His reputation rests mainly on his famous picture 'The Lost Sheep,' of which over 300,000 reproductions have been sold in the United States and the British Isles. He exhibited frequently at the Royal Academy and the Paris Salon.

Among his sacred subjects were a 'Crucifixion' and 'The Supper at Emmaus.'

SOOTY TERN. See Egg-bird.

SOPHIA, empress of Constantinople, niece of Theodora and wife of Justinus II. She was a beautiful, clever and ambitious woman, and after the accession of Justinian II to the throne in 565 was the real ruler of the country. Her husband's successor, Tiberius II, was chosen by her advice, and after the death of Justinus in 578 she planned to become the wife of Tiberius. Finding her designs frustrated she conspired against him, but her plot being discovered, she was deprived of power and compelled to live the remainder of her life in privacy.

SOPHIA DOROTHEA, wife of George I, king of England and elector of Hanover: b. 15 Sept. 1666; d. Ahlden, Hanover, 23 Nov. 1726. She was the only child of George William, Duke of Brunswick-Lüne-Celle, and in 1682 was married to her cousin, George Louis, then crown prince of Hanover. She had two children, George II of England, and Sophia Dorothea, wife of Frederick William of Prussia and mother of Frederick the Great. Her life at the court of Hanover was made exceedingly wretched by the relatives of her husband, who himself eventually was turned against her. She was accussed of indiscreet relations with Count Philip Christoph von Königsmark, and the charges were substantiated by letters later proved forgeries. The count was assassinated in connection with the affair, and Sophia Dorothea was divorced in 1694. She lived the remainder of her life a prisoner at Ahlden, for which reason she has sometimes been called the «Princess of Ahlden.» Consult Williams, W. H., 'The Love of an Uncrowned Queen' (1900); Greenwood, A. D., 'Lives of the Hanoverian Queens of England' (1909).

SOPHIOLOGY, sō'fĭ-ŏl'ō̆'jĭ, the scientific study of the origin and development of the philosophies of the various races of man. The science constitutes the natural history of science and philosophy from their earliest beginnings in the observations of primitive tribes, and traces their development into the achievements of civilized nations.

SOPHISTS, the designation applied to certain schools of philosophers in Greece, which occupied the transition period between the older and ruder cosmical philosophies, and the more refined subsequent systems, which beginning with Socrates, Plato and Aristotle, were founded primarily on the study of the human mind as the perceiving, thinking, reasoning and knowing subject. In the older systems the direct relation of mind to the objective universe did not receive prominent attention. The hypothesis of a unity in the external variety was assumed without dispute, and a theistic or materialistic interpretation of this unity formulated according to the tendency of the school. In this manner arose a succession of systems which were agreed in being artificial cosmogonies, unrelated if not hostile to the current traditions of religion, and however superior to these current notions as the efforts of great minds to comprehend the relations of things, they were still unable to stand the inevitable criticism of comparison with fact. Of this comparison and criticism the sophists were the exponents, and its force fell both on philosophy and religion. But none of the sophists were really great men, at least in comparison with those who succeeded them, and they appeared in an age of political decline and social corruption.

The direct services of the sophists to philosophy appear to have been small and negative. It is too much to attribute to them as a merit the introduction of subjective philosophy. This, as its simultaneous appearance in different schools proves, was no more than a necessity of the period to which they belonged. What chiefly marks the sophists was their incapacity to generalize the subjective element, in consequence of which they were not philosophers properly so called, but only the critics of a dying philosophy. But the sophists rendered to science and literature, and even indirectly to philosophy, much greater services than as philosophers they were able to render to philosophy. They have been not inaptly compared to the French encyclopædists. They belonged to all the liberal professions; they taught all the usual branches of knowledge. Some of them were distinguished as rhetoricians and grammarians, others as men of science. They frequently made a profession of universal knowledge, and though from their overweening estimate of the newly found subjective element of knowledge they carried this pretension so far as to profess to speak of subjects of which they knew nothing, all their pretensions were not equally frivolous. Rhetoric, to which they naturally gave undue importance, was systematically studied by them, and they supplied some of the earliest models of good Greek prose. They are accused, however, particularly the later sophists, of being not only superficial in their attainments, but mercenary, vain-glorious and self-seeking in their aims.

Protagoras of Abdera, the earliest and one of the most important of the sophists, was contemporary with Socrates, but considerably older; he applied the Heraclitan doctrine of the universal flux of all things to the mind, maintained the uncertainty of the existence of the gods and the relativity of all truth. Man, he said, is the measure of all things. That is true for the individual which for the time being he perceives or feels. Sense and the gratification of sense are the only relations which subsist between man and the external world. All opinions are equally true, and contradictories may be affirmed with equal authority. Protagoras is said to have been the first who taught for pay, and though he left his pupils to fix his remuneration according to the amount of benefit they had received, he is said to have become wealthy. Gorgias of Leontini came to Athens in 427 B.C. as an ambassador from his native city. He affected great pomp, and studied to excel in the splendor of his rhetoric. Founding upon Zeno, he took a bolder stand in scepticism (q.v.) than Protagoras. His book was called 'Of the Non-Existent or of Nature'; and his three cardinal propositions were that nothing exists, that if anything exists it cannot be known, that if it could be known it could not be communicated. Gorgias reaches these conclusions by a logical quibble, in which he plays off Heraclitus against the Eleatic school. The scepticism of Gorgias, however, like that of other sophists, as it was founded on a superficial logic, was neither very profound nor very consistently developed. His successors applied it chiefly in a moral direction, which made Plato call the art of rhetoric as taught by Gorgias a corruption of justice. Hippias of Elis represented the law as a tyrant in compelling men to act contrary to nature. Thrasymachus made the gratification of desire the natural right of the stronger and might the law of nature. Critias, one of the 30 tyrants, ascribed faith in the gods to the invention of politicians. Prodicus of Ceos taught a morality more in accordance with ordinary conceptions of right. Some of his moral discourses are preserved and are still admired for the feeling they display. His teaching was recommended by Socrates, and he has sometimes been called his predecessor. Prodicus is said to have been exorbitant in his charges for instruction. He taught rhetoric to Euripides. Consult Grote, G., 'History of Greece' (new ed., New York 1899); Schanz, M., 'Die Sophisten' (Göttingen 1867); and the various histories of ancient philosophy.

SOPHOCLES, sŏf'ō-klēz (496–406 B.C.), was born in the deme of Colonus near Athens. His father, Sophillus, was a man of middle rank and owner of many slaves. Hence he had the means to give his son a good education. Naturally, then, Sophocles was early introduced to Homer, who has left his impress on all the poet wrote. Music was not neglected. In this branch the young Sophocles was trained by the famous musician, Lamprus. He also frequented the palæstra and won prizes in gymnastic and athletic contests. His beauty and natural grace were exceptional. At the age of 15 he was chosen to lead the chorus that sang the pæan of victory of Athenian arms over Oriental despotism. Of the poet's relation to the great philosophers we know nothing; but we may be reasonably sure, from the internal evidence of his works, that his mind was not eager to pry into the unknown. With Voltaire he might have said "Adorons Dieu sans vouloir percer ses mystères."

Sophocles was born when Athens was beginning to rise toward the zenith of her glory and he died in his 90th year, just before her brilliant sun had set. He lived to witness the passing success of Athenian arms at Arginusæ, but died before her star was obscured by the cloud of Ægospotami. It was the century of Cimon and Pericles, of Phidias and Ictinus. Greece was the centre of the world, Athens the hearthstone of Hellas, the home of art, literature, science. But amid all this unrest, opportunity and glory, Sophocles lived a life of imperturbable placidity. Calm and self-possessed, he dedicated his life to his art. As Browning has well said, his even-balanced soul business could not make dull nor passion wild. Only one cloud cast a momentary shadow over his long and serene life; his son Iophon arraigned him before his deme as incapable of managing property. The old man refuted the charge by reciting the ode he had just composed on his native Colonus. For public affairs the poet showed no great aptitude. Pericles did not have a very high opinion of his strategic abilities, and the great statesman had an excellent opportunity of judging, for Sophocles was elected to serve with him as a general to conduct the Samian War. The appointment, we are told, was due to the success of his 'Antigone.' Later he became a colleague of Nicias. He was also a minor priest, and one of the treasurers that managed the tribute paid to Athens by her allies. The poet met Herodotus and composed an ode in honor of the historian. Sophocles was probably also acquainted with a great many other distinguished men. There is a wealth of ideas, a sprightly grace and a delicacy of views in his works that could not have developed in any other atmosphere. After the Sicilian reverse he was elected a member of the college of six magistrates created to propose measures of safety. In 411 he was appointed on a committee of 30 to modify the constitution; but he was conservative in politics and withdrew from all participation in their work when they proposed to rule without consulting the general assembly.

With his first tetralogy Sophocles competed with Æschylus for the tragic prize and won (468), although he was only 28 years of age. We are told that when the archon was hesitating to draw lots, Cimon, who had just returned from his conquest of Scyrus, entered the theatre and proceeded to pour out a libation to Dionysus, whereupon he and his fellow-generals were detained to act as judges. Henceforth Sophocles was master of the stage. He produced on an average one tetralogy every two years. No other tragic poet ever secured a greater number of prizes. Sometimes, in the earlier days, he took the leading part himself. He not only played acceptably the title rôle of Nausicaa, but he also distinguished himself by his grace in dancing. Æschylus died in distant Sicily; Euripides mid the wilds of Macedonia; but Sophocles, though invited by foreign potentates to their splendid courts, lived and died in the city of his birth. Sophocles' manners were affable and pleasing. His conversation was full of that Socratic irony which we find so charming in the dialogues of Plato. Endowed with a serene composure of manner and gifted with gentleness, beauty and intellect, small wonder that his contemporaries believed that the poet was beloved by the gods. After death the Athenians worshipped him as a hero. To the whole Greek world he was known as the Attic Bee. But in the natural sweetness of his temper there was something bitter — a tang which produced the flavor. It was his charm and grace that commended Sophocles especially to the Greeks. He was a more perfect artist than Æschylus and Euripides. The Periclean Age showed a decided preference for him over the other two. In the eyes of the Athenians, Sophocles was next to Homer, unsurpassed in wit, sweetness, discourse, art.

Sophocles found the art-form already developed. But he tempered the tone of tragedy, the material of which he narrowed to the compass of a single play: there is no nexus between the parts of his trilogies. In Sophocles, too, the characterization becomes sharper, and the dialogue moves more briskly, the action becomes more complicated, the meshes of intrigue finer. There is also a marked difference between Sophocles and Æschylus in the space devoted to the chorus. The lyric simply reflects, no longer bears the piece, though it is still an integral part of the action. But the plot is developed with consummate skill and with the most exact thoughtfulness. The plot of ‘Œdipus Rex’ is so subtly articulated that each episode, each period, each verse, becomes an indispensable part of the whole. Not even Edgar Allan Poe strove more earnestly for totality of effect. It is this articulation that makes conspicuous the “irony” that runs through Sophocles. But it is particularly in the portrayal of character that Sophocles is in advance of Æschylus. The latter evokes fear, Euripides pity, Sophocles both — and in due proportion. The plot assists in the development of the character. The poet's theme is man. His heroes are ideal, but they show genuinely human traits. The gods are kept in the background. As in Æschylus, they control the action, but from a point so high above our horizon that we are not conscious of their domination until we reach the *dénouement*. Sophocles was not only a dramatist: he was also a poet. In all Greek poetry there is a strong current of feeling for external nature; but in Sophocles this feeling is always exquisitely adapted to dramatic effect.

Many innovations were made by Sophocles. He increased the number in the chorus from 12 to 15, developed the parados, introduced a third actor and made great use of stage scenery. Sophocles has his inevitable perfection; but he is not uniform enough to be faultily faultless. His poetry is never jejune, but succulent, full of sap and marrow; and he is the one consummate master of style, melody, vocabulary and versification, the one poet that always maintains a noble Homeric grace, that never sinks below the calm level of high art. His style is vigorous, but it is also marvelously subtle. No poet better combines severity with variety and sweetness with vigor in his rhythmic measures. He always adapts rhythm to expression. His choral songs are constructed with the skill of a master architect. Of the hundred and more plays which Sophocles wrote seven have come down to us. In ‘Œdipus Rex’ Sophoclean art reaches its highest point. The ‘Trachiniæ’ is the least popular; nevertheless, it is a good play. The ‘Œdipus at Colonus’ is the least dramatic, but its charm and breadth indicate that it is the work of the poet's best years. The earliest extant play is the ‘Ajax’ (451). The ‘Antigone’ was produced three years later. The ‘Philoctetes’ is one of the latest (409), while the ‘Œdipus at Colonus’ was brought out (401) by his grandson after the poet's death. The ‘Electra,’ though hard for a modern to appreciate, is the only one on this theme that thoroughly satisfies, the ‘Chœphori’ of Æschylus and the ‘Electra’ of Euripides being inferior.

Joseph E. Harry,
Author of ‘The Greek Tragic Poets,’ etc.

SOPHOCLES, Evangelinus Apostolides, American Greek scholar: b. Tsangaranda, Thessaly, 8 March 1807; d. Cambridge, Mass., 17 Dec. 1883. He was educated at Amherst College. In 1842 he became a tutor in Greek at Harvard, and in 1860 professor of ancient and modern Greek there. His chief work, a ‘Greek Lexicon of the Roman and Byzantine Periods,’ was published in 1870. He wrote also a Greek grammar (1838); ‘History of the Greek Alphabet’ (1848); ‘Glossary of Later and Byzantine Greek’ (1860), revised as ‘A Greek Lexicon of the Roman and Byzantine Periods’ (1870).

SOPHONISBA, Carthagenian lady, daughter of Hasdrubal, son of Gisco: d. about 204 B.C. She was early betrothed to Masinissa, a Numidian prince, but in 206 B.C. her father gave her in marriage to Syphax, a rival Numidian prince allied with Carthage. Masinissa was allied with the Romans, and in the Second Punic War he defeated Syphax and captured Sophonisba. He either married her or was about to do so when Scipo Africanus interposed, fearing that Sophonisba might influence him in favor of Carthage, Masinissa's former ally. To save Sophonisba's falling into Roman captivity Masinissa provided her with poison, with which she killed herself. Her story has been the theme of many tragedies, among them those of Nathaniel Lee (1676); Thomson (1730); Trissino (1529); Del Carretto (1502); Mariet (1631); Corneille (1662); Alfieri (1783).

SORA, a bird of olive-brown above striped with black and streaked with white, found in marshes of the Atlantic coasts of the United States. It is a member of the rail family. The species *Parzana carolina,* or Carolina rail, frequents the marshes of the Atlantic Coast in great numbers in the early Fall. It attains a length of about eight inches. During the breeding season the underparts become a slate gray and the face and throat become black. The bird makes a nest of grass on the ground in its swampy retreat and lays from 7 to 15 eggs, buff colored with brown spots. It breeds from the Middle States north and in winter is most numerous from Virginia southward. See Rail and Rail Shooting.

SORANUS, Greek physician: b. Ephesus and lived in the reign of Trajan and Hadrian, 98–138 A.D. He practised medicine at Alexandria and at Rome, and wrote several medical treatises, as well as a life of Hippocrates which is the main source of our information concerning the great physician. The lives of other physicians written by him have been lost. Of his medical treatises two remain in the original, ‘On Fractures’ (Ideler, J. L., ‘Physici et Medici Minores,’ Vol. I, 1841); and ‘On Diseases of Women’ (Rose, V., 1882). His most important medical work was ‘On Acute and Chronic Diseases,’ of which but a few fragments of the original remain, but of which a Latin translation by Cælius Aurelianus is in existence. Consult Christ, W., ‘Geschichte der griecheschen Literatur’ (5th ed., 1913).

SORATA, sō-rä'tä. See Illampu.

SORBON, Robert de, French theologian, founder of the Sorbonne: b. Sorbon, 9 Oct. 1201; d. Paris, 15 Aug. 1274. He studied for the priesthood, became canon at Cambrai and then through the influence of the Comte d'Artois, was appointed chaplain to King Louis IX. He gained the esteem and patronage of the pious ruler, who aided him in his chief project. This was the foundation of a college, or rather place of study, for students of theology. The result was the establishment of La Sorbonne. Several of his treatises and sermons have survived. Consult Jadart, M., ‘R. de Sorbon’ (Rheims 1880).

SORBONNE, sŏr'bōn, Paris, France, a celebrated college of Paris, founded in the 13th century at the instigation of Robert de Sorbon (q.v.). The school was erected near the Palais des Thermes, in what is now the Quartier Latin. The name was originally «La Communauté des pauvres maîtres étudiant en théologie» but by popular usage «La Sorbonne» was substituted. The ancient college was not a place of classes and lectures, but rather a residence hall for students of theology. There were several grades of students: beneficiaries, residents and associates. The administration was entrusted to a principal, a prior, a procurer and a librarian, all elected at a general assembly. Students of all countries were admitted until the 15th century, when it was opened only to French students. The library grew to such large proportions that in 1841 a separate building was erected. The influence of the Renaissance brought about the founding of several chairs in the humanities, particularly in Greek philosophy.

The most important event in the history of the Sorbonne in the 17th century was the reconstruction of the buildings by Richelieu, the «second founder.» Enlarged and well established now, the college became more than ever before the centre of intellectual activity. It was hostile toward the Reformation and toward the new spirit of scientific inquiry which animated the Cartesian school. In its religious doctrine, it remained Jansenistic and conservative.

In 1792 the entire school was abolished by decree. It was not revived until 1821, when it was re-established with the three faculties of theology, science and letters. In 1852 the Sorbonne was given to the city of Paris and became incorporated in the university; the Ecole pratique des Hautes Etudes was added in 1868. Some 20 years later, the faculty of religion was dispersed and the Sorbonne, which had led the intellectual religious thought of France for several centuries, became purely secular and scientific in its courses.

The new building was erected in 1889 from the plans of M. Nenot, winner of a «Grand Prix de Rome,» the front of which, on the side of its official entrance, extends 274 feet along the Rue des Ecoles; then in an irregular oblong of from 700 to more than 800 feet, the building climbs the hill along the Rue Saint Jacques. Incorporated in the building is the 17th century church containing the tomb of Cardinal Richelieu. The building has hundreds of lecture-rooms, well fitted for their purpose, and many excellent laboratories.

It serves for the two faculties of letters and sciences of the university. It includes none of the professional scientific schools, which are located in the vicinity. The new Sorbonne also contains the Ecole Nationale des Chartes which has a remarkable library of archives. The professors number more than 100 and the students some 10,000. There are also numerous assistants. Consult Franklin, A. L. A., ‹La Sorbonne, ses origines, sa bibliothèque, etc.› (Paris 1875); Greard, O., ‹Nos adieux a la vieille Sorbonne› (Paris 1893); Rashdall, H., ‹Universities of Europe in the Middle Ages› (Oxford 1895); Agathon, ‹L'Esprit de la nouvelle Sorbonne› (3d ed., 1911).

SORCERY. See WITCHCRAFT.

SORDELLO, sŏr-dĕl'lō, Italian poet: b. near Mantua, Italy, about 1200; d. about 1270. He was one of the most celebrated of the early Italian poets who wrote in the style of the earlier troubadours and in their Provençal language. His history is variously narrated. Benvenuto d'Imola, Dante's commentator, describes him as a citizen of Mantua, a fine soldier and a courtier. He lived at the time of Ezzelin of Romano whose sister Cuniza conceived a violent passion for the poet. She pursued him, and since he was still deaf to her pleas, and on the instigation of the suspicious Ezzelin resorted to flight, she plotted to have him captured and slain. The story of his life is the subject of Browning's ‹Sordello,› and is mentioned by Dante in his ‹Divine Comedy› where he appears in the ‹Purgatorio› as the type of excessive patriotic pride. His best-known poems are ‹L'Ensenhamen d'onor,› and the complaint over the death of Blacas, in which the sovereigns of the world are invited to partake of the heart of the brave man. Some 30 of his poems have survived.

SORDELLO, a narrative poem by Robert Browning (q.v.), first published in 1840. It is based on the study of an historical but indefinite character, Sordello, the most celebrated of the Italian troubadours, b. Mantua, at the beginning of the 13th century, who owes his fame to the works of later poets from Dante to Browning rather than to the originality of his adventures or to the excellencies of his verse, chief of which are the didactic poem ‹L'Ensenhamen d'onor,› some love songs and satires. Like ‹Paracelsus,› published in 1835, Browning makes his ‹Sordello› a study in the psychology of genius, illustrating its besetting temptations. Sordello the poet, distracted between the demands of idealism and imagination and the desire to utter the thoughts of humankind, finally gives up poetry for practical politics and gets into difficulties which can only be solved by his death. Browning is said to have devoted more time to Sordello than to any other work, and probably became so familiar with the story which he set out to tell that he failed to make allowance for the general reader, for the obscurity generally complained of in his verse reached its climax in ‹Sordello.› This is owing to the subtlety and intricacy of the psychological expositions as well as to the vagueness with which the story is rather hinted than told. The obscurity of his style and philosophical subtleties, due it is believed to Germanic tendencies inherited from the maternal grandfather, injured his literary reputation with the reviewers, and it was not surprising that ordinary readers were puzzled and indifferent, and that the general recognition of his genius was long delayed by the reputation he acquired for obscurity. Sordello, however, with its powerful analysis of character and appreciation of the subtler springs of conduct, exhibited all the qualifications of a great dramatist. Abounding in descriptive passages of genuine poetry, the subtlety and vigor of thought are surprising and justify the frequent comparisons of higher critics to Shakespeare.

SOREL, sō-rĕl, **Albert,** French author: b. Honfleur, 13 Aug. 1842; d. 29 June 1906. He was a correspondent of the academies of Cracow, Munich, Copenhagen, Stockholm and Berlin, and of the Royal Historical Society of London; he was licentiate of law, secretary-general to the president of the Senate, 1876–1902; president of the upper commission of national archives, vice-president of the commission of diplomatic archives; also, professor at the Free School of Political Sciences. He wrote 'Histoire diplomatique de la guerre franco-allemande' (1875); 'L'Europe et la révolution française' (1885–1904); 'Etudes de litérature et d'histoire' (1882–1901); 'Madame de Staël' (1891).

SOREL, Georges, French author: b. Cherbourg, 1847. He was educated at the Ecole Polytechnique, and afterward became a civil engineer with the Department of Bridges and Highways, but resigned from the service in 1872. He was one of the founders of *Devenir Sociale,* to which he became a contributor, also contributing to *Le Mouvement Socialiste,* and other periodicals. He is a leader of the syndicalist movement and one of the foremost writers on the subject. Author of 'Le procès de Socrate' (1889); 'L'Avenir socialiste des Syndicats' (1900); 'Saggi di critica del Marxismo' (1903); 'Reflexion sur la Violence' (1909; Eng. trans., Hulme, T. E., 'Reflections on Violence,' 1912; 2d ed., 1915).

SOREL, Canada, town and county-seat of Richelieu County, Quebec, on the Richelieu River at its confluence with the Saint Lawrence at Lake Saint Peter, and on the South Shore and Quebec Southern railways, 45 miles northeast of Montreal. It is built on the site of a 17th century fort, and was formerly called William Henry. It has a good harbor, which is the winter quarters for many of the Saint Lawrence River steamboats. It also has extensive ship-building and ship-repairing interests and manufactories of mill machinery, engines, ship stores, plows, leather, stoves, brick and tile, flour and lumber. The trade in grain and farm produce is important. The town is well built, has substantial county and other public buildings, good schools, a number of handsome churches, hotels, banks and weekly newspapers. Pop. about 8,500.

SOREL RIVER. See RICHELIEU.

SORGHUM, sôr'gŭm, an annual cane-like plant (*Holcus sorghum*), resembling Indian corn in general appearance and habit of growth. The sorghums are without ears, and are distinguished by heavy heads of small seeds which terminate the stalk. (See GRASSES). The cultivated varieties are usually treated as a distinct species by botanists, but some prefer to consider them as derived from a wild species, *Holcus halepensis.* The sorghums have been known from the remotest periods of history, and the cultivation of sorghum probably had its origin in Africa, where a variety called durra is grown over the whole continent, and is put to a variety of uses; the negroes chew the stem for the sugar, and make alcoholic drinks from the grain. Varieties of sorghum were known in China from a very remote period. The first sweet sorghum seed to reach the United States came from that country; in 1855, and in 1856 from South Africa. The sorghums are remarkable for their adaptability to differing conditions of soil and climate, and an almost endless list of varieties exists, which may be divided into two main groups based upon the character of the sap. Those containing a considerable amount of sugar are classed as saccharine sorghums; those weak in sugar as non-saccharine. The name "sorghum" is applied in common use to the saccharine varieties only, while the non-saccharine kinds commonly bear the name of their species, as Kaffir corn, durra, etc. The several varieties of the sweet sorghums are so nearly alike that little distinction is made in treating them as a class. The two leading varieties are the amber and the orange, the former being the favorite in the more northerly latitudes of the United States, and the latter in the South and the Southwest. Sorghum thrives in every part of the United States except in the colder parts of New England and in the higher parts of the Rocky Mountains. At first it was grown exclusively for the manufacture of syrup and sugar, but as its value as a forage crop became known, the area devoted to its cultivation increased rapidly.

Saccharine Sorghums.— The Civil War caused a scarcity of sugar in the United States, and sorghum syrup came into widespread use as a substitute. In 1860, five years after the first seed was introduced from China, 6,749,123 gallons of sorghum syrup were made and consumed in the United States. In 1870 the production had swelled to 16,050,089 gallons, and in 1880 to 28,444,202 gallons. Since that time the production of sorghum has shown a steady decrease, being only 16,532,382 gallons in 1918. In the manufacture of syrup the stalks are stripped of their leaves after the seed has ripened, and the tops are cut off. The stalks are then cut off close to the ground and passed through heavy rollers to extract the juice, which is then boiled in shallow pans until a syrup of the desired consistency is obtained. The greater part of the sorghum now manufactured is a farm product, all of the operations of manufacture being performed on the farm. In 1878 the United States Department of Agriculture took up experiments to ascertain whether sugar could be manufactured profitably from sorghum. Two objects were aimed at in the experiments, (1) to discover a cheap process for extracting the juice and making the sugar and (2) to increase the sugar content of the plant. Considerable progress was made along both these lines, and the chemists in charge of the work at one time thought that sorghum would become a competitor of sugarcane as a source of sugar. Attempts were made by capitalists to manufacture sorghum sugar on a commercial scale, but none of these attempts have proved successful. The only satisfactory process of getting the sugar to crystallize properly involves the use of a large amount of alcohol, which, under present government regulations, is so expensive as to make the process impracticable.

Sorghum is valued highly by stockmen as a soiling crop, and makes good summer pasturage for all kinds of stock. Its high sugar content gives it an especial value in fattening swine, and it is also an excellent food for sheep. As ensilage it makes good feed, but on account of the difficulty in preventing the development of acidity in the silo, other crops are generally preferred for this purpose. Sorghum is of especial value as a pasturage plant, owing to the fact that it is at its best in midsummer, when other grasses are generally of the least service. The heavy yield of hay makes it one of the favorite forage crops. In pasturing, care is necessary on first turning stock upon sorghum, owing to the danger of bloating.

The time for planting sorghum varies according to latitude from the 1st of April to the middle of June. In general the best results are obtained by sowing the seed broadcast or with a drill, as oats or wheat are sown. When intended for a soiling crop it is sometimes better to sow in rows far enough apart to admit of plowing between the rows. The amount of forage yielded per acre varies according to soil, climate and methods of cultivation, and ranges up to as much as 15 tons of the cured hay. Two or three crops are sometimes harvested in a single year, and as much as 10 tons is sometimes obtained from a single cutting. Experiments at the Nebraska Experiment Station showed sorghum to be the heaviest yielder of all the forage crops at that station. It is a deep-feeding plant, and gives better results on poor land than does corn, but is more exhausting to the soil. In feeding sorghum the whole plant is usually used. The seed alone has a feeding value of about 90 per cent of that of corn, and is valued highly for poultry, especially for laying hens. Bulletin 15 of the Department of Agriculture compares the composition of sorghum seed and corn as follows: Corn (shelled), water 10.9; ash 1.5; fibre 2.1; fat 5.4; protein 10.5; nitrogen-free extract 69.6; sorghum seed, water 12.8; ash 2.1; fibre 2.6; fat 3.6; protein 9.1; nitrogen-free extract 70.0.

Non-saccharine Sorghums.— These exist in many varieties, all with the same general habits of growth, being slow to germinate and requiring a long period to mature seed as compared with corn. They differ in the length, thickness and strength of the stem, in the number and size of the leaves and in the position of the seed-head. The principal varieties are Kaffir corn, Milo maize, durra (doura, dhourra or dhoura), Jerusalem corn and broom corn. All of these varieties except the last are grown principally as feed for stock. The peculiar adaptability of broom corn to the manufacture of brooms and brushes has led it to be devoted entirely to this purpose.

Kaffir corn is the best known of those grown as feed for stock. It was introduced from South Africa about 1884, distributed by the Department of Agriculture and has been found well fitted to the semi-arid regions of the West and Southwest, where corn has never been a reliable crop. It is now extensively cultivated in Oklahoma, western Kansas and other places where lack of moisture gives this crop an advantage over corn. In appearance Kaffir corn resembles sorghum, but does not grow so tall. The leaves are large and long, the head is upright and compact, and the seeds vary in color according to variety. Three distinct species have been generally agreed upon — red, white and black-hulled white. The last frequently goes by the name of African millet. Kaffir corn is used chiefly for a fodder crop, is planted in drills and cultivated like corn or sorghum. Where it is proposed to feed the whole fodder to stock, the crop is cut and shocked as soon as the grain is ripe. Where the heads are to be harvested by themselves various methods of harvesting are used. The yield is about the same as that of corn grown under the same conditions, except in dry, hot regions, where the Kaffir corn will outyield Indian corn. The crop of fodder produces up to eight tons per acre or more, but the seed has a lower feeding value than corn. The grain has been used as an article of human food, making a meal similar to corn-meal. The acreage of Kaffir corn is about 266,513 acres, and the yield of grain averages annually about 5,169,113 bushels.

Milo maize closely resembles Kaffir corn, but grows to a greater height. It is marked by a heavy foliage and an abundance of suckers. Owing to the fact that it requires a long period to mature it has been found best adapted to cultivation in the Southern States. Two varieties are grown in the United States, white and yellow.

Durra differs from Kaffir corn principally in the position of the head, which hangs downward from the end of the stalk, the culm being recurved just below the panicle. This variety includes Egyptian corn, rice corn, guinea corn, etc. The grain is a favorite poultry-food, and the plant has been extensively cultivated in some parts of the United States for this purpose. It is also valuable as a forage plant.

Jerusalem corn grows to a height of four to eight feet, but produces less forage than other varieties. The grain yield is large as compared with that of other non-saccharine sorghums, but is hard to save, owing to the fact that the grains are without husks and shatter easily. The head hangs downward on a recurved stalk as in the case of durra.

Broom Corn.— Broom corn is the oldest variety of the non-saccharine sorghums cultivated in the United States. Brooms were made for sale in the United States as early as 1798, and the plant was cultivated for home use for some time previous to this. The usual development of the stems of the seed-cluster adapt it perfectly to the purpose of brooms and brushes, and it is not cultivated for any other purpose, although sometimes fed to stock after the brush has been removed. There are several varieties, whose distinctions depend on the size and coarseness of the plant and the quality of the head. The plants are usually grown in drill rows. The heaviest producers of broom corn are the States of Illinois and Kansas, though considerable quantities are produced in many other States. The American broom corn is superior to that grown in Europe for purposes of broom manufacture.

Diseases of Sorghum.— Sorghum blight (*Bacillus sorghi*) is a bacterial disease in which the leaves or leaf sheaths are attacked by small red spots and patches of various shades and sizes. The roots are also subject to attack from the same source, and the vitality of the plant is so affected that it is either stunted or killed. The disease is worse on some varieties than others, but it attacks both the saccharine and the non-saccharine varieties. Of the smuts, *Ustilago sorghi* and *U. reiliana* are dreaded. The former attacks the grain, causing it to swell up and burst, and the latter attacks the entire head, converting it into a large black mass which is covered at first by a whitish membrane. No preventive treatment has been applied successfully.

Sorghum Poisoning.— Cases have been frequent, especially in the semi-arid districts, of cattle dying from eating even a little green sorghum, usually a second-growth. Investigations carried on by the Nebraska Experiment Station go to show that under some conditions sufficient prussic acid forms in the leaves of the plant to cause the death of an animal. The danger is confined to the feeding of the green plant.

SORITES, sō-rī'tēz, *in logic,* a chain of elliptic syllogisms — of syllogisms in which the conclusion of all except the last is omitted. The syllogisms are stated in a series of propositions so linked together that the predicate of each is the subject of the one next following, until a conclusion is formed by bringing together the subject of the first proposition and the predicate of the last. The chain can be carried to any length provided it is perfectly consecutive, so that each term except the first and the last occurs twice, once as subject and once as predicate. Example of sorites: Every A is B. Every B is C. Every C is D. Every D is E. Therefore, every A is E. The term is also used to designate a fallacy wherein it is argued that since the addition of each single object to a collection of objects does not change the collection up to a certain point, therefore, such addition can be made indefinitely without changing the collection.

SOROCABA, sō-rō-kä'bä, Brazil, a town in the state of São Paulo, situated on the railroad, 55 miles west of São Paulo. It lies in the midst of a rich agricultural and grazing district, and important fairs for the sale of horses and cattle are held in the town annually. Pop. of commune about 17,000.

SOROLLA Y BASTIDA, Joaquin, Spanish artist: b. Valencia, 1863. He studied at the academy at Valencia, and later in Italy and Paris. He achieved wide recognition upon the exhibition of his ‹Another Margaret› (1892) which was awarded a gold medal by Madrid. and was purchased by the Saint Louis gallery. Thereafter his successes were continuous and remarkable, and he is generally considered the leader of modern Spanish painters. His work includes landscapes, figure paintings and portraits, and is of the impressionistic school. His exhibit at the Paris Exposition in 1900 was awarded a medal of honor, and after his phenomenally successful exhibit in Paris in 1906 he was made an officer in the Legion of Honor. His exhibits at London in 1908 and at the Hispanic Society, New York, in 1909, were also remarkably successful. Among his paintings are ‹Fishing Boats Return› (Luxembourg, Paris); ‹Sewing the Sail› (gold medals, Munich and Vienna); ‹A Sad Inheritance› (church of the Ascension, New York); ‹Swimmers› (Metropolitan Museum, New York); ‹After the Bath› and ‹Beaching the Boat› (loaned to the Metropolitan Museum by the Hispanic Society); portraits of King Alfonso XIII and of Queen Victoria of Spain (Hispanic Society, New York), etc. Others of his works are in the Berlin National Gallery, the Venice and Madrid Museums and in private collections in England and America.

SOROSIS, the name of the first professional woman's club established in the United States. Sorosis was founded in 1868 by Mrs. «Jennie June» Croly (q.v.) and some of her literary associates in New York. Mrs. Croly was for many years the president of the society.

SORREL, SORREL-TREE, SORREL VINE, etc., are the like names of several unrelated plants having acidulous or «sour» foliage. The field or sheep sorrel is the *Rumex acetosella,* a common pasture weed, naturalized from Europe, with halberd-shaped leaves, impregnated with oxalic acid, slender panicled racemes of delicate diœcious flowers, with six-parted green or reddish calyces. It spreads widely by creeping rootstocks and in late summer colors large patches of dry fields and hillsides by its crowded rusty-hued flower stalks and foliage. This species, *R. acetosa,* and particularly *R. scutatus,* which is cultivated for the purpose in Europe, are used for salads, soups and as vegetables. They are cooling, diuretic and anti-scorbutic plants. The wood sorrel may be any one of the American species of *Oxalis,* low plants with succulent tripartite leaves and obcordate leaflets and pretty solitary or umbellate five-parted flowers, white, pink or yellow, and with sharply acid sap. Indian sorrel is the roselle, an East Indian mallow (*Hibiscus sabdariffa*) cultivated in the tropics for its acidulous calyces which are made into refreshing drinks, jellies and tarts. Switch sorrel is *Dodonæa viscosa,* a widely distributed tropical shrub, with acid and bitter foliage. Climbing sorrel is the shrubby *Begonia scandens,* which climbs by rootlets. The sorrel vine is a low, tendril-bearing climber (*Cissus acida*) of tropical America. *Oxydendum arboreum* is the sour-wood or sorrel-tree of the southern United States. It is a smooth-barked tree of the heather family, with alternate oval leaves, deciduous and sour in taste. The five-parted cylindrical flowers are in one-sided, slender racemes and in terminal panicles. They have a honey-like odor, and are food for bees. The capsules are pyramidal, five-valved and a soft, pale green in color. The leaves are occasionally used to furnish a black dye, and the wood serves for tool-handles, bearings of machinery and for turning.

SORREL COOL DRINK. See HIBISCUS.

SORRENTO (ancient SURRENTUM), Italy, in the province of Naples, on the southeast side of the Bay of Naples, seven miles southwest of Castellamare. It is built on the steep mountainous slope of a promontory extending into the bay, in one of the most beautiful and fertile regions of Italy, amid orange, lemon, olive and mulberry groves. A roadway following the coast forms a favorite promenade from the town to Castellamare. Sorrento contains a few interesting ruins of its ancient splendor belonging to the Augustan period. It is the seat of an archbishop and has a cathedral. Other buildings are a seminary and a school of navigation; also a monument to Tasso, who was born here. The wine of Sorrento is famous. The inlaying of wood and silk-culture; the manufacture of silk, cultivation of fruit, stock-raising and fisheries are the chief occupations. It depends, however, mainly upon its attractions as a summer resort, which it owes to a fine climate and picturesque scenery.

SORROWFUL MOTHER, Sisters of the. See ORDERS, RELIGIOUS.

SORROWS OF YOUNG WERTHER, The (‘Die Leiden des jungen Werthers’). ‘Werther's Leiden,’ Goethe's first novel, was written in Frankfort in 1774, during the so-called storm and stress period. It is divided into two books each consisting of a series of letters by Werther, with some reports by the supposed editor of these letters inserted in the latter half of the second book. The principal character of this novel is a refined, sensitive youth of artistic temperament, who makes imperative demands upon life from a subjective point of view and when disappointed becomes absorbed in himself. This tendency to brood which is dangerous in itself proves fatal in Werther's case on account of his hopeless love. For his endeavor to overcome the latter by leaving Lotte and starting out on a life of activity fails. He falls a victim to his unalterable disposition and the unconquerable power of his passion. Such a «leitmotif» characterizes ‘Werther's Leiden’ as a genuine product of the storm and stress movement. But this movement was confined to Germany, and the sweeping success of the novel, which called forth translations, imitations and also parodies in all literary languages must be accounted for by other reasons. It appeared in an age of sentimentalism and met the demand for sentimental elements to a considerable degree. Besides, great general problems dealing with man and nature, art and religion are presented in a vigorous style, and the portraits of the persons, especially those of Werther and Lotte, are distinguished by a convincing realism. The most noteworthy of the admirers of Goethe's ‘Werther’ was Napoleon I.

‘Werther's Leiden’ is closely connected with the life of its author. During Goethe's stay at Wetzlar, 1772, where the young lawyer was to get practical experience at the Supreme Court of the empire, he met and admired Charlotte Buff who was engaged to a young man, Albert Kestner. There is, however, this fundamental difference between Goethe's life and Werther's: Goethe did not return to Lotte after he had once left her, and while Werther complains about the vanishing of his artistic faculty, it was his very talent that enabled Goethe to overcome his feelings for Charlotte Buff by giving them artistic form. Thus only the first book is really based on Goethe's own experience while the second is based on the tragic fate of his colleague, Jerusalem, who for reasons similar to those of Werther committed suicide. Consult edition of Goethe's works in ‘Deutsche National-Literatur’ (Vol. XVIII 13, pp. 1–134, 1882–98); Kestner, A., ‘Goethe und Werther, Cotta'sche Handbibliothek’; Glöel, Heinrich, ‘Goethe's Wetzlarer Zeit’ (1911); Long, O. W., ‘English and American Imitations of Goethe's Werter’ (*Modern Philology,* Vol. XIV, No. 4, August 1916.

EWALD EISERHARDT.

SORSOGON, sōr-sō-gōn', Philippines, (1) Pueblo, capital of the province of Sorsogon, Luzon, on Bay of Sorsogon. The bay is 19 miles in length from the town to its entrance and affords one of the best harbors in the Philippine Archipelago. Sorsogon is a port of call for steamers from Manila, and has a considerable export trade, particularly in hemp and copra. In 1840 it suffered from an earthquake which lasted almost continuously for 35 days; the churches were destroyed, 17 persons were killed and many injured, and the ground for some distance sank five feet below its former level. Pop. about 15,000. (2) Province of the island of Luzon, situated in the extreme south-eastern end of the peninsula of Luzon, bounded on the north by the province and the Bay of Albay, and on the south by San Bernardino Strait, length from northwest to southeast 47 miles; greatest width, 40 miles; area, 755 square miles. The coast line is very irregular; on the northwest coast is the deep indentation of the Bay of Sorsogon; and on the northeast coast Sógod Bay, an arm of Albay Gulf; from the extreme northeast shore of the Bay of Sorsogon to the nearest waters of Sógod Bay the distance is but three miles. The mountain system of the province includes a range in the north, forming the boundary line with Albay and another range extending from northeast to southwest, forming the central watershed, but nearer the east coast than the west. In this range is the active volcano of Bulusan, visible for 60 miles at sea. The largest river of the province rises on the western slopes of Bulusan; there are many small tributary streams. There are comparatively few highways, one road connecting Sorsogon with Bacón on the opposite coast. There are several trails, and much coastwise trade in native canoes. The staple products of Sorsogon are hemp and copra (a product of the cocoanut, the form for shipment to be made into oil), and large quantities of both are exported. Native textiles, cordage, etc., are manufactured from the hemp; and the cultivation and manufacture of hemp, and the cultivation of the cocoanut are the principal industries. Sorsogon was formerly a district of the province of Albay, and in 1901 was created a province and placed under civil government in accordance with the provision of the law of the Philippine Commission. Pop. about 130,000.

SORTES, sôr'tēz, (Virgilianæ, Homericæ, Biblicæ, etc.), a mode of divination by means of a passage or verse in some poet's works or in the Bible. One way of practising this kind of divination was to open the book at random and to take whatever passage or verse is touched by the finger as an indication of the fortune of the inquirer. Another way was to select a number of verses from a poet or from one of the books of the Bible, write them on slips of paper, mix these in an urn, draw one slip at random and from its contents infer good or evil. The Sibylline oracles (see SIBYL) were also employed in this way. Sortes Virgilianæ are so called, as being practised with verses from the poet Virgil, Homericæ from Homer, and so on. In Persia *sortes* are determined by resort to the poems of Hafiz. It is said that the Roman Emperor Severus, who reigned from 193 to 211 A.D., found an intimation of his high destiny in that verse of the Æneid,

> Tu regere imperio populos, Romane, memento;

and that the Emperor Gordianus (self-slain after a reign of 36 days) read his doom in this passage of the same poem:

> Ostendunt terris hunc tantum fata, nec ultra
> Esse sinunt.

Charles I and Lord Falkland tried the Sortes Virgilianæ in the Bodleian Library at Oxford and found passages equally ominous to each. The use of the Scripture books for divination still lingers among people of simple faith; and the obstinate survival of this superstition is due to a strong conviction of the power and watchful care of an overruling Providence and a belief in the Bible as an inspired manual of divine guidance: if resort is less often had in these times to the Sortes Biblicæ, that may be due to the decaying respect for the mere letter of Scripture.

SOSIOSH, or SAOSHYANT. The promised Messiah of the Soshyantos or fire-priests of the early Iranian religion. A son of the seed of Zarathushtra or Zoroaster, thrice parthenogenetically and miraculously reincarnated, he is to be the last of the three great prophets who after 9,000 years are to appear successively at the end of each millennium, until the 12,000 years expire between the creation, the end of the world and the judgment day. See ZOROASTER and related references.

SOTHERN, Edward H., American actor, son of E. A. Sothern (q.v.): b. New Orleans, 1859. He first appeared with his father in a small part in New York (1879). He starred in ‹One of Our Girls› at the Lyceum in New York in 1885. Shortly thereafter he appeared at the head of his own company in such plays as ‹Lord Chumley,› ‹Maister of Woodbarrow,› ‹Prisoner of Zenda,› ‹The King's Musketeers,› ‹Lovelace,› ‹If I were King,› ‹The Proud Prince,› and ‹Hamlet› (1900). His interpretation of ‹Hamlet› is modeled somewhat on that of Edwin Booth, is romantic and effective, but at times prone to exaggeration. In 1904 he began to play Shakespearean rôles with Julia Marlowe, whom he married in 1911. After his wife retired in 1915, he appeared in the ‹Two Virtues› and in several revivals. A year later he announced his own retirement. Consult McKay and Wingate, ‹Famous American Actors of To-Day› (New York 1896); Strang, ‹Famous Actors of the Day in America› (Boston 1900); Sothern, ‹My Remembrances› (*Scribner's Magazine,* New York January 1916 et seq.).

SOTHERN, Edwin Askew, English actor: b. Liverpool, England, 1 April 1826; d. London, 21 Jan. 1881. He was educated for the church, but discovered soon that his inclinations were for the stage. In 1849 he joined a company of strolling players, and soon afterward passed into the stock company of the Theatre Royal, Birmingham. From 1852 he appeared in the United States without attracting much attention until in 1858 ‹Our American Cousin› was brought out in New York, with Sothern cast for the small part (47 lines) of Lord Dundreary. Sothern built up the character, making it the leading feature of the play, and one with which his name has ever since been connected. He acted other parts, with more or less success, and was always popular in America, which he frequently visited. Consult bibliography under Sothern, E. H.

SOU, soo, an old Roman, Gallic and French coin, of gold, silver and copper. In France the current five centime piece, 20 of which make a franc, are commonly called sous.

SOUARI, or SUWARRO, NUTS, the seeds of the genus *Caryocar* (family *Caryocaraceæ*), lofty trees yielding timber prized for its durability and common in British Guiana. *C. nuciferum* is the chief source of supply of these nuts, having digitate leaves, five- or six-parted, large, magenta-colored flowers and a fruit which is a spherical, hard, woody shell, as large as a child's head, reddish-brown in color and covered with roundish protuberances. It contains four seeds, the souari nuts, which are kidney-shaped, about the size of an egg, with a ruddy brown shell, that is very hard but has a satiny lining and encloses a soft, pure white kernel in a brown skin. This rich meat, with its sweet, almond-like flavor, is considered to be the finest of all nuts. A bland oil is expressed from the kernels and they are called butter-nuts in the English market, or cream-nuts in the American. Since there is great difficulty in gathering them, on account of the bulk of the trees, the supply is restricted.

SOUBISE, soo-bēz, **Benjamin de Rohan,** SEIGNEUR DE, French Huguenot soldier: b. Rochelle, France, 1583. He was a son of René II, Vicomte Rohan, and a younger brother of the soldier-writer, Henri de Rohan. He served his apprenticeship as a soldier under Maurice of Orange and when the religious wars broke out in 1621 was entrusted with the chief command of the west, while his brother commanded the land forces in the south. In 1625 Soubise made a daring attack on the royalist fleet in the river Balvet and occupied the island of Oleron. He also commanded in the defense of Rochelle, but was unable to save the town and when it fell he fled to England.

SOUDAN, soo-dön'. See SUDAN.

SOUFFLÉ, soo-flā', a dish consisting chiefly of the whites of eggs, to which other ingredients (chocolate, cheese, vanilla, orange-flower water, rose water, various essences, etc.) are added, to give consistency, flavor and variety. The materials have to be agitated with a whisk until the whole is in a creamy froth, which is then baked in a soufflé pan.

SOUFFRIÉRE, La, lā soo-frē-är. See SAINT VINCENT.

SOUL, *in philosophy* the basis of the unity of individual consciousness and conduct. The opinions held as to the nature of this basis have naturally varied in accordance with the current views as to unity and explanation. The savage, for example, can find no principle of explanation that is not at once a tangible object and the bearer of human attributes, so that in his eyes the soul becomes a homunculus, a man within the man. The transition from the view of the savage to that of the uneducated man in a civilized community consists at most in the discardance of the grosser material attributes of the soul, without the loss of any of its anthropomorphic qualities. It requires a certain degree of philosophical sophistication to become aware that any explanation of the soul which is to convey real knowledge must not involve the equally complicated notion of a person. The first explanations of the soul which are to be found in Greek philosophy resemble all the explanations of their period in that they make use of a material principle. This material principle, which is the magnet in the philosophy of Thales, air in that of Anaximenes, fire in that of Heraclitus and the finer atoms among the Atomists, is considered to be a moving force. Anaxagoras made the first great advance in the theory of the soul by isolating the notion of moving force from that of a particular material substance. The Pythagoreans adopted a view which may be regarded as an anticipation of Aristotle, in that they held the soul to be the harmony of the body. In this pre-Socratic period all the accounts of the soul place a preponderant emphasis on its cognitive nature.

It is only with Plato that the nature of the soul comes to be the cardinal problem of philosophy. He assigns to it a place intermediate between not-being and the realm of Ideas. The world-soul is the harmony of «sameness,» that is universality such as pertains to the Ideas and «otherness,» or the particularity characteristic of the things of sense. The soul of the individual is a less perfect copy of the soul of the universe. The soul is immortal and uncreated and the universals of our knowledge are but the recollection of what we have learned in a previous life. The soul cannot be destroyed, for it partakes in the idea of life itself. The body is the prison of the soul and prevents it from returning to its home in the realm of Ideas. Each soul contains three parts — a desiderative. a spirited and a rational. That soul in which the rational preponderates will resume that life of which all souls originally partook — the blessed life of a star.

The Aristotelian view of the soul is peculiarly interesting in that it involves motives which are active in the philosophy of the present day. He places the soul definitely in that category of being corresponding to the Platonic Ideas — the realm of pure forms. The soul is the formal cause of the human body and since the body is an organism, the soul is also the final and efficient cause. In Aristotle's own language, the soul is the entelechy of the body. Like the Platonic soul, the Aristotelian soul is tripartite. It contains a vegetative part, which superintends the functions of assimilation and propagation and constitutes the entire soul of plants; an animal soul, characterized by the powers of locomotion and sensation, which supplements the vegetative soul throughout the animal kingdom and a rational soul, found only in man. The principle of unity connecting these three faculties is not explained. The question of the oneness of personality is complicated by the notion of the soul as an immaterial principle. Aristotle denies immortality to the soul, which he conceives to be created like the body in the act of begetting.

The Stoic psychology is essentially materialistic. The soul is nothing but fire or breath uniting the body much as the world-soul of fire unites the world. The soul consists of reason, the power of reproduction, speech and the five senses. Personal identity resides in the reason, but the individual soul is a part of the world-soul. The soul exists after death, though not for an eternity. Epicureanism took over bodily the psychological theory of atomism. The soul, according to the Epicureans, is made up of the finest fire-like atoms, the movements of which are sensation and thought. Immortality is completely denied. Lucretius distinguishes two levels of psychical life; the lower, animal *anima*, and the higher *animus*, presiding over emotion and cognition. The Neo-Platonists consider intelligence, soul and matter as successive emanations from the One-Soul, is consequently prior to body, and more real than it. This opinion is in the philosophy of the Gnostics combined with the tripartite division of human nature characteristic of the older Platonism. In place of the desiderative part of man, according to the Platonic philosophy, they put the body; in place of the spirited part, the soul; in place of the intellectual part, the spirit. Corresponding to the ethical and religious trend of Gnosticism, the highest place is no longer given to reason, but to that new element which enters into the human soul upon conversion. In the later Christian philosophy, the «soul» and «spirit» are fused into a single entity. In Saint Augustine there are found many of the motives which characterize later mediæval and modern philosophy. The body-soul dualism based on the distinction between thought and extension appears in his philosophy as well as in that of Descartes. He retains the Aristotelian notion of the soul as final cause and disclaims all knowledge of the origin of the soul.

The Scholastic doctrine of the soul is essentially Aristotelian. In the form held by Saint Thomas and now the official philosophy of the Catholic Church, it consists of the following dogmas: (1) the soul, which is not divided after the fashion indicated by Aristotle, is the form of the body; (2) it is a substance, but is incomplete in the sense that it has a natural fitness for association with a body; (3) it is spiritual and without extension; (4) it is created at a definite moment in the development of the organism. Of course, the scholastics all maintained the immortality of the soul.

The modern period of philosophical thought is marked by a very important change in the notion of the soul, as has been shown. The scholastic philosophy perpetuated the Aristotelian concept of the soul as form or entelechy. While it is true that the scholastics regarded the soul as a substance, they considered it, not as merely coequal with matter, but as the organizing factor in the soul-matter complex which constitutes man. The body was thus in a sense subordinated to the soul. On the other hand, in the philosophy of Descartes, soul and body are co-ordinated as respectively the thinking and the extended substances. As a substance is that which possesses attributes, it is quite a different sort of thing from the Aristotelian form, which gives to matter its attributes. The soul substance is of course differentiated into individual souls; bût of the nature of this differentiation Descartes says little or nothing. The existence of my individual soul is guaranteed to me by the famous principle, «I think, therefore I am.»

After the Cartesian dialectic has established the existence of God and the material universe, the next problem is the correlation of the experiencing soul and the material objects of its experience. This correlation, which according to Descartes is guaranteed by the perfect honesty of God, is supposed to take place in the pineal gland. The Occasionalists go beyond Descartes in that they make the correlation between the soul and the matter depend on the act of God in each particular case. The culmination of this trend of thought is to be found in Spinoza, who maintains that mind and matter are not separate substances at all, but merely two among the infinite number of attributes of the Divine Substance. Another offshoot of Occasionalism is the philosophy of Leibnitz. Instead of a dualism of mind and matter, his philosophy is a pluralism of different soul-substances, which in confused perception may give the appearance of matter. The correlation between the content of an individual soul and the universe which this content represents is established through an act of God which has pre-established the harmony of the universe. Unlike the continuous divine intervention of Occasionalism, this act was finished once for all at the creation of the universe.

The rationalistic school of the Continent, as has been shown, ended, so far as the concept of soul is concerned, just about where it began. For Descartes, the Occasionalists, and Leibnitz, the soul is essentially substance; and even for Spinoza, it is a divine attribute possessing much of the autonomy of a Cartesian substance. Like the rationalists, the British empiricists began with a substantial notion of the soul, but unlike the rationalists, they carried the notion to its absurd logical conclusion and transcended it. Locke considered the soul after the fashion of Descartes, as a substance, as the substratum of ideas. He made it a blank tablet on which the ideas are impressed, but beyond this he did not characterize it. Though he was sure that self-consciousness exists, he made no psychological investigation into its nature. Berkeley for all his incisive criticism of the Lockeian notion of substance in its application to the material world, left the notion of soul untouched. It remained for Hume to do for mind what Berkeley had done for matter and to point out the fact that introspection alone was unable to reveal a specific soul-entity. Putting this fact side by side with the inability of the notion of a substratum to give a real explanation of anything, he came to the conclusion that the mind is neither more nor less than the sum total of its states.

Kant, who was awakened by Hume from his «dogmatic slumber,» was not the least under his influence in the matter of the soul. While he most emphatically asserts that a soul exists, he denies that it is immediately accessible to perception. He points out, in the course of his discussion of the paralogisms of rational psychology, that the aprioristic Wolffian psychology is based on a confusion between the subject, which must exist in some sense or other in every act of consciousness, and the simple, lasting, personal soul. The soul, qua substance, is inaccessible to us, and the entire worth of a dialectical discussion of psychological matters lies in the criticism to which it subjects such theories of the soul as materialism or the opinion that we have a direct intellectual acquaintance with a permanent, personal ego. Thus all metaphysical proof of immortality falls to the ground, as likewise does all metaphysical disproof. The immortality of the soul, however, is established as a postulate of the pure practical reason — of the reason as applied to affairs of conduct. The existence of morality requires that there should be a progress *in infinitum* of the imperfect human will toward the perfection enjoined by the moral law. Kant's attitude towards the soul may be summed up in the statement that the soul can only be thought by the pure reason, but may be known by the practical reason. This ability of the practical reason to grasp matters that are partly veiled to the pure reason is known by Kant as the primacy of the practical reason. The Kantian primacy of the practical reason is repeated in the philosophy of the romanticists under the form of voluntarism. Fichte and Schopenhauer both emphasize the part played by the will in the constitution of the soul. The ego, which is the basis of the entire Fichtean philosophy, is grasped in a voluntary act of intellectual intuition, which exhibits to us the law of duty. The ego is immediately aware of its own free act. For Schopenhauer, as later for Bergson, the intellect is but a schematization of the will, which constitutes the true nature of the human being as well as of the universe. Hegel agrees with the Kantian refutation of rational psychology, but regards the Kantian antinomies constituting Kant's refutation merely as a few of an indefinite number of antinomies having their roots in Being itself. Herbart makes the soul one of his undefined primitive concepts. It is simple, absolute and transcends the bounds of space and time. Its only activity is self-preservation and ideas arise when it acts to preserve itself in opposition to another real. Lotze considers that the soul and body interact and that mind is but the higher, explicit development of what is found in the grossest matter. The philosophy of Fechner is likewise a panpsychism (q.v.) which makes the entire universe consist in a hierarchy of souls subordinated to the world-soul of God, whose body is Nature.

Among the more interesting of the current views concerning the nature of the soul is that which assimilates the soul to the phenomena of life in general. While this is the tendency of all vitalists, it reaches the highest degree of metaphysical development in the philosophy of Henri Bergson. Bergson's philosophy is based on the contrast between two aspects of the universe: between the immediately given living time and the atomic space, known only through the analytic powers of the intelligence. The temporal aspect of the universe is identified with the spiritual force of life. Accordingly the true nature of the self is inaccessible to the formal, deadening intellect and can be grasped only through intuition. In this aspect, as grasped by intuition, it transcends all individuation and personality. It is the same living force which exemplifies itself throughout all nature. Only through the damming of the stream of life by matter does the individual soul arise with its concomitant body. Empirical psychology is of itself unable to transcend the individual soul and see the greater reality that lies behind. The Bergsonian philosophy, that is, points out the limitations of a rational account of the soul and indicates a superrational mode of approach — psychology. As Bergsonianism treats of matters which it claims are not properly subject to the reason, it is clear that it claims for itself an intuitive basis. Whether the Bergsonian intuition exists or not is a sheer question of fact; it is certain at any rate that there are many who do not feel an intuitive compulsion to accept Bergson's view of the soul.

At present there is a strong tendency to return to what is in a sense the Humian view of the soul. James and the American school of Neo-Realism (see Realism) agree to the extent that they consider the soul as the stream of its states and maintain that these states, in a different context and arrangement, form the subject matter of the physical science. This view, similar as it is to that of Hume, marks at once a great advance over that of Hume and a partial revival of Aristotelianism. The stream of states is not a mere fortuitous aggregæ of experiences; A's experiences and B's experiences are each united in a manner totally different from the manner in which some of A's experiences can be united to some of B's. In other words, this theory, which calls itself neutral monism, makes the soul consist, not merely of certain states which are aggregated, but of a system of states-in-a-peculiar-mode-of-aggregation. The distinction between these alternatives was inadmissible for Hume because of his nominalism. On the other hand it may be expressed in Aristotelian languages by calling the mode of aggregation the entelechy of the stream of states. Like Aristotelianism, neutral monism finds the unity of consciousness in the embodiment of a form or structure or relation, but unlike Aristotelianism, it maintains that the matter shaped by this form is not the body, but the stream of consciousness itself.

Neutral monism has recently been subjected to a keen and unfavorable criticism by Bertrand Russell. His objections are (1) that introspection shows that knowledge does not consist in the entry of an experience into a system of experiences, but in a direct relation to a mind or soul; (2) that neutral monism cannot account for the relation of belief; (3) that the thought of a timeless thing is in time, so that the thing and the thought cannot differ merely in their context; (4) that neutral monism is adapted to explain rather the knowledge of things than that of facts; (5) that there are «emphatic particulars» such as «this» and «I» and «now.» It is possible, however, to modify neutral monism so as to avoid much of the force of these objections. To begin with objection (3), it is not essential for neutral monism to maintain that every experience is identical with its object. This much of nominalism is valid, that in much of our thinking, the ultimate objects are supplanted by their symbols. There is nothing controverting the principles of neutral monism in the supposition that in a certain context one experience datum may acquire a vicarious interpretation as another. (See Meaning; Thought). Neither is it in any way impossible or unlikely that the timeless should be presented to us directly. Putting these two possibilities together it is clear that the thought of a timeless thing may be in time just by virtue of the fact that the situation in which the timeless thing occurs is symbolized by a complex of similar structure, but consisting of temporal entities. Belief is also explained by the self-representative character of experience. A belief is a situation where a complex of experiences plays the part of a symbol complex toward another complex with the structure of which it has not been definitely compared. As to neutral monism and the knowledge of facts, there is no reason why experience should not contain fact-states as well as thing-states. Immediate acquaintance with facts offers no difficulties, while descriptive knowledge is merely such knowledge as is mediated by a symbolism. The objection that introspection conflicts with neutral monism is certainly not conclusive, as introspection is no more infallible than other varieties of observation. The Russellian resolution of a table into an aggregate of aspects or empirical data calls for a philosophical sophistication which should not be appalled by the apparently unitary character of the soul. Finally, the distinction between the focus and periphery of attention may be taken as a fact without the assumption of any soul-entity behind it, yet it is quite sufficient to account for the existence of emphatic particulars. See Dualism; Idealism; Monism; Psychology; Realism.

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Norbert Wiener.

SOULE, soo-lā', **Gideon Lane,** American educator: b. Freeport, Me., 25 July 1796; d. Exeter, N. H., 28 May 1879. He was a student at Philips Exeter Academy in 1813-16 and was graduated at Bowdoin College in 1818. He was afterward for more than 50 years connected with the Phillips Exeter Academy, of which he was principal in 1838-73. He was chiefly responsible for the great success of the institution.

SOULE, Joshua, Methodist Episcopal Church South, bishop: b. Bristol, Me., 1 Aug. 1781; d. Nashville, Tenn., 6 March 1867. He began his career as a «boy preacher» at 17, studied indefatigably and acquired a reputation as an opponent of Calvinism, Unitarianism and Universalism. He became presiding elder of the State of Maine in 1804, when but 23; and served on the committee which drafted the constitution of the church in 1813. He became bishop in 1824, and upon the division of the church in 1845 he went with the Methodist Church South, becoming its senior bishop. He was a man of wide influence. He retired at 72. Consult Dubose, H. M., 'Life of Joshua Soule' (1911).

SOULÉ, Pierre, American statesman: b. Castillon, France, September 1802; d. New Orleans, La., 26 March 1870. He received most of his education at Toulouse, having been interrupted in his studies at Bordeaux by an accusation of complicity in a plot against Louis XVIII, in consequence of which he was obliged to flee. Soon after his pardon in 1824 he was again exiled on account of the publication of articles in his paper *The Yellow Dwarf*, derogatory to the course of the ministers of Charles X, and took up his residence at this time in America. A few years later he was elected to the United States

Senate from Louisiana, and was still later entrusted with the negotiations of the United States government with Spain for the purchase of Cuba. During the Civil War he was a member of Beauregard's staff. At the conclusion of hostilities he took up his law practice in New Orleans.

SOULT, soolt, **Nicolas-Jean de Dieu,** marshal of France: b. Saint-Amans-la-Bastide, department of Farn, 29 March 1769; d. Soultberg, 26 Nov. 1851. He entered the army as a common soldier, but was soon distinguished for gallant conduct and raised from the ranks. In the campaign of the upper Rhine in 1792–94 he was brevetted general of brigade, and in 1799 was made general of division and served with distinction as such under Massena in Switzerland and Italy. He became an ardent champion of Napoleon by whom he was appointed marshal at the beginning of the Empire (1804). His military genius was further proven at Austerlitz, where he decided the battle by cutting in two the main body of the Russian troops, and in numerous other battles, the most conspicuous being that of Friedland in the Prussian campaign in 1807. Upon the fall of Napoleon he was appointed Minister of War by Louis XVIII, but was compelled to resign by the royalist party. He acted as major-general of the army at Waterloo, but was obliged to flee from France at the second Bourbon restoration. Returning in 1819, he was again appointed Minister of War, and in 1839 Minister of Foreign Affairs. In 1846 he was created grand-marshal of France, and retired to private life. He was created a peer of France and under Louis Philippe was a prominent official. Consult Soult, 'Mémoires' (3 vols., Paris 1854); Thiers, 'History of the Revolution and the Empire'; and Salle, 'The Political Life of Marshal Soult' (1834); Dumas, J. B., 'Neuf mois de campagne à la suite du maréchal Soult' (Paris 1907).

SOUND. See ACOUSTICS; VIBRATION.

SOUND, The, or OERESUND, é'räsoond, Denmark, the easternmost of the three channels which connect the Kattegat with the Baltic Sea. It separates the Danish island of Zealand from the southern extremity of Sweden. Its length is about 30 miles, and its breadth varies from less than three miles at the northern end, between Elsinore and Helsingborg, to 16 miles between Copenhagen and Malmö. Its depth varies from four to 20 fathoms. Since the opening of the Kaiser Wilhelm Canal the Sound has lost some of its importance, but is still navigated by numerous vessels Sound duties were formerly levied by Denmark on all ships passing through it, but these were abolished in 1857.

SOUNDINGS, the operation of trying the depth of deep water and the quality of the bottom, especially by means of a plummet sunk from a ship. In navigation two plummets are used, one called the hand lead, weighing about eight or nine pounds, and the other, the deep-sea lead, weighing from 25 to 30 pounds. (See LEAD). The former is used in shallow waters, and the latter at a distance from shore. The nature of the bottom is commonly ascertained by using a piece of tallow stuck upon the base of the deep-sea lead, and thus bringing up sand, shells, ooze, etc., which adhere to it. The scientific investigation of the ocean and its bottom has rendered more perfect sounding apparatus necessary, and has led to the invention of various contrivances for this purpose. See OCEAN.

SOURLAKE, or SOUR LAKE, Texas, city in Hardin County, about 20 miles northwest of Beaumont, in an agricultural region and a section rich in oil. For several years Sourlake was a health resort, taking its name from springs which possessed medicinal properties. In 1902–03 prospectors began to sink oil test-wells in the pine forests around the springs, with the result that oil in large quantities was found. So many derricks were erected in rows so closely together, that one portion of the oil-field was called the «Shoestring district.» Sourlake was at once connected with Beaumont and Port Arthur by pipe lines until such time as its own storage buildings were ready for use. Considerable of the oil is sent direct to refineries. The first part of the year 1902, Sourlake was a stretch of prairie at the edge of a pine forest; 1903 saw it a village of about 200 inhabitants with some visitors to the springs. The census of 1910 gave the population as 4,900.

SOURSOP, the edible fruit of *Annona muricata*, a small, much-branched, oramental tree, cultivated in the East and West Indies. This fruit is large, pear-shaped, covered with soft prickles, greenish outside, but containing a white succulent pulp, with an odor suggesting black currants, and a peculiar, but pleasant, subacid taste.

SOUSA, John Philip, American conductor, composer and author: b. Washington, D. C., 6 Nov. 1854, son of Antonio and Elizabeth Sousa. At the age of 11 he first appeared in public as violin soloist; at 15 he was teaching harmony; in 1876 he became one of the first violinists in the orchestra conducted by Offenbach when the latter visited America; later he became conductor for various theatrical and operatic companies. In 1880 he was appointed leader of the band of the United States Marine Corps in Washington, serving under Presidents Hayes, Garfield, Arthur, Cleveland and Harrison until 1 Aug. 1892, when he resigned from the United States service to organize the Sousa Band, which has since then made 38 semi-annual tours throughout America, and has visited Europe five times, giving a total of more than 10,000 concerts in 1,000 cities, and covering over 700,000 miles of travel. In 1910, beginning in New York on 6 November, he inaugurated a tour of the world, and visited with his band, Europe, Canary Islands, Africa, Tasmania, Australia, New Zealand, Fiji Islands, Hawaiian Islands, British Columbia and toured across the Continent back to New York, returning after 14 months' travel. Since his band was organized, he has appeared at the most prominent of the great expositions in this country and in Europe, the last and most important being the Panama-Pacific International Exposition in 1915 in San Francisco. As composer of music he established a «march style» of his own which has been recognized the world over, and he has been called the «March King» in every country. Some of the best known and most popular of his productions in this field are 'The Washington Post,' 'High School Cadets,' 'Liberty Bell,' 'Manhattan Beach,' 'Semper Fidelis,' 'The Gladiator,' 'The Stars and Stripes Forever,' 'Invincible Eagle,' 'Hail to the Spirit of Liberty,' 'Hands Across the Sea,' 'The Charlatan,' 'The Bride-Elect,' 'El Capitan,' 'King Cotton,' 'Imperial Edward,' 'Jack Tar,' 'The Diplomat,' 'The Free Lance,' 'The Fairest of the Fair,' 'The Federal,' 'From Maine to Oregon,' 'The Lambs,' 'The Pathfinder of Panama,' 'The New York Hippodrome,' etc. He has also written several Suites, including, 'Three Quotations,' 'Looking Upwards,' 'Maidens Three,' 'At the King's Court,' 'Last Days of Pompeii,' 'Dwellers in the Western World,' 'People Who Live in Glass Houses,' 'Tales of a Traveler,' 'The American Maid' and 'Impressions at the Movies.' Also, an historical scene, 'Sheridan's Ride,' and a symphonic poem, 'The Chariot Race.' He has composed a long list of songs and miscellaneous pieces, and a number of light operas, some of the latter being 'The Smugglers,' 'Desiree,' 'The Queen of Hearts,' 'El Capitan,' 'The Bride-Elect,' 'The Charlatan,' 'Chris and the Wonderful Lamp,' 'The Free Lance' and 'The American Maid.' As author, he compiled under the auspices of the United States government, 'National, Patriotic and Typical Airs of all Countries,' wrote the book and lyrics for the opera, 'The Bride-Elect,' also numerous magazine articles and verses; and has produced two novels, 'The Fifth String' and 'Pipetown Sandy.' With his band he has appeared twice, by command, before King Edward and Queen Alexandra of England, once at Sandringham, and then at Windsor. On the first occasion he was honored by His Majesty with the decoration of the Victorian Order. He has also received the Grand Diploma of Honor of the Academy of Heinault, Belgium, and has been decorated by the French government with the Palms of Academy, besides making him an Officer of Public Instruction.

SOUSA, sō'zä, or **SOUZA, Martin Alfonso de,** Portuguese colonist and governor in South America: b. Bragança, about 1500; d. Lisbon, 21 July 1564. In 1530 Sousa, an army officer, was dispatched in command of a fleet of five sail with a force of 500 to colonize Brazil. The commonly-received statement is that he discovered the bay which is supposed to be the mouth of a river and named Rio de Janeiro, 1 Jan. 1531. But there is some doubt as to whether he was in the bay on that date, and there are records of earlier visits by others. On 22 Jan. 1532 he founded at São Vicente the first Portuguese colony in Brazil. There he introduced the sugarcane, which he had brought from Madreia, and built the first sugarmill in the country. In 1533 he was recalled, and in 1534 made captain of São Vicente, whose affairs he continued to administer, though he did not again visit it. He was admiral of the seas of India in 1534–40, and governor of the Portuguese East Indies in 1542–45.

SOUTANE', a close-fitting long coat reaching to the ankles, which is the distinctive dress of clerics in the Roman Church. See CASSOCK; COSTUME, ECCLESIASTICAL.

SOUTH, SIR James, English astronomer: b. London, October 1785; d. there, 19 Oct. 1867. He was educated as a surgeon and gave up a large practice in London to pursue the study of astronomy. In 1816 he fitted up a private observatory at his home, and devoted all of his time to astronomical investigation. He was the discoverer with Sir John Frederick William Herschel of 380 double stars, which were catalogued by them in 1833. In 1835 he removed his telescope to France, where he made other important observations. He was knighted for his services in behalf of science in 1830. He was the first president of the Astronomical Society, of which he was also a founder. Among his important observations were Encke's comet (1828 and 1838); Mauvais' comet (1844), and Vico's (1845).

SOUTH, Robert, English Anglican divine: b. Hackney, 4 Sept. 1634; d. Westminster, 8 July 1716. He was educated at Oxford and after traveling on the Continent took orders in the Church of England in 1658. He was university orator 1660-77, became prebendary of Westminster in 1663, in 1667 was made chaplain to the Duke of York, and in 1670 was appointed canon of Christ Church. In 1676 he accompanied Lawrence Hyde, afterward Earl of Rochester, who went as Ambassador to Poland, and on his return was appointed rector of Islip, Oxfordshire. South's hatred of Roman Catholics was as strong as his contempt for Puritans. He hesitated for some time at the event of the Revolution over the matter of his allegiance but finally adopted the parliamentary fiction that the flight of James was in effect an abdication. In 1693 he entered upon his great controversy with Sherlock, dean of Saint Paul's, occasioned by the latter's 'Vindication of the Doctrine of the Trinity' which South answered by his anonymous 'Animadversions,' full of learning and incisive logic as well as fierce sarcasm and petty personalities. To Sherlock's 'Defense' South published a rejoinder, 'Tritheism charged upon Dr. Sherlock's new notion of the Trinity'; and the controversy became the talk and ridicule of the town until the king himself intervened. In 1713 he refused the see of Rochester and the deanery of Westminster. His sermons are masterpieces of clear thought, direct and vigorous in English, sometimes rising to eloquence, often spiced with a wit and sarcasm unusual in pulpit utterances, and straining at times the bounds of propriety. His sermons were published by himself in 1679–1715; an additional volume in 1717 contained his 'Memoirs' and the account of the Polish travels. Modern editions were published in 1823, 1842, 1843, 1845, with the 'Memoir,' and 1850.

SOUTH AFRICA, an ambiguous geographical term embracing (a) only British South Africa, or (b) British South Africa plus Portuguese East Africa and that territory formerly known as German South-West Africa. Although the term is generally applied to that part of the continent south of the Zambesi, below the 14th degree of southern longitude, a portion of British South Africa, viz., North-East Rhodesia, reaches eight degrees further north, to Lake Tanganyika. If we accept that boundary line as the extreme northern limit, then South Africa would include not only the whole of Portuguese East Africa and a third of German East Africa, but also entire German South-West Africa and three-fourths of Angola. Officially, however, the British territory north of the Zambesi is styled British Central Africa. Leaving out Portuguese possessions, for which see PORTUGAL; and the former German territories, for which see SOUTH-WEST AFRICA and EAST AFRICA, there remains the subject of this article, British South Africa.

This great territory comprises the Union of South Africa (q.v.), composed by the Cape of Good Hope, Natal, the Transvaal and the Orange Free State, Rhodesia and Northern Rhodesia, the Bechuanaland Protectorate, Swaziland and the native territory of Basutoland. All these will be found under separate heads. Together with Walfish Bay (430 square miles), the area of British South Africa is 1,205,357 square miles, with a population at the last census of 8,102,861, being approximately 1,310,027 whites, 6,610,535 natives and 182,299 Asiatics. Geographically it lies between 8° and 35° south, and 12° and 36° east. The Belgian Kongo and former German East Africa bound it on the north, the Nyasaland Protectorate and Portuguese East Africa on the east, Angola (Portuguese) and German South-West Africa, now called the South-West Africa Protectorate, on the west. The extreme length, from the Kongo border to Cape Agulhas, is close on 2,000 miles; greatest breadth, 900 miles. Only Cape Colony and Natal border on the coast, washed in the west by the Atlantic Ocean, and in the south and east by the Indian Ocean. The toal coastline of Cape Colony, from the Orange to the Umzimkulu estuaries, is roughly 1,300 miles; that of Natal, about 380 miles. Prominent headlands along the coast are Cape Castle, Cape of Good Hope, Danger Point, Cape Agulhas, Cape Saint Francis and Cape Recife, enclosing a number of inlets or exposed roadsteads — Table Bay, Saint Helena Bay, False Bay, Plettenbergs Bay, Mossel Bay, Saldanha Bay and Algoa Bay. For the most part the coastline is low-lying and inhospitable; the harbors are mostly unprotected and the river-mouths are choked by sand-bars. Behind the seaboard rise ramparts of hills shutting off the interior. In places the mountains, which run parallel to the coast, run down close to the sea, as at Table Bay (3,582 feet high). The highest points are in the southeast, on the Drakensberg, which in places rises to a height of 10,600 feet. The various ranges almost form a succession of steps leading to the great table-land of the interior. The Transvaal is practically a large plateau from 4,000 to 6,000 feet above sea-level. The High Veld, the highest part of the Transvaal Province has consequently a healthy and bracing climate. A large part of the interior plateau, of which the northern part includes Rhodesia and Nyasaland, is flat or only diversified by worn remnants of hills. The great Kalahari Desert and other extensive areas are largely or wholly semi-desert or «Karroo,» while the most fertile regions lie on the southern and eastern coastlands. With little interruption a similar terraced formation extends throughout the southeastern region between Kafirland and the Limpopo. The Lobombo Mountains, a single chain of about 3,000 feet, traverse Zululand, Swaziland and the Transvaal, while the inner and higher escarpments, sweeping round the extremity of the continent from the Orange estuary to the Limpopo, are here continued beyond the Stormberg as the Randberg or Drakenberg range, and reach an altitude up to 10,000 feet. On the outer slope, falling seaward through a series of terraces, lie Natal and Zululand. The nucleus of these highlands is formed by the Antelope or Potong Mountain at the converging point of Basutoland, Natal and the Orange River Free State, and constitutes the main divide between the waters flowing west to the Orange Basin and east to the Indian Ocean. From here the Drakenberg turns northward and culminates in the highest point of the Transvaal, the Mauchberg, 8,730 feet high. The surface of the Orange Free State is mostly level or gently undulating, with some ridges of hills and numerous isolated, generally flat-topped, eminences called «kopjes,» rarely more than 500 to 700 feet high, though the whole plateau is from 4,000 to 5,000 feet above sea-level. Immediately north of the Transvaal lies Southern Rhodesia, separated by the Limpopo River, and extending northward to the Zambesi. An elevated region runs through this territory from the source of the Shashi on the west, in a northeasterly direction to the source of the Manyami River, and thence southeastward to the sources of the Pungwe and Odyi. The watershed between the Zambesi and Limpopo drainage areas runs along this elevated backbone in the central and western portions, and between the Zambesi and Sabi farther east. The most famous landmarks of Rhodesia are the great Victoria Falls and the Matoppo Hills, where the founder of the country, Cecil Rhodes, is buried.

The drainage of South Africa is effected by the Orange River flowing into the Atlantic, the Zambesi, Limpopo and other streams into the Indian Ocean, as well as numerous small streams. Owing to the steep fall, and the intermittent supply of rain, only the Zambesi is at all available for navigation. That river, which forms a great delta on the coast of Portuguese East Africa, divides Southern Rhodesia from British Central Africa. It is navigable by steamers of light draught from its mouth for 300 miles to the Kebra Basa rapids above Tete; a steamer placed on the river above those rapids has reached the mouth of the Gwai, 600 miles farther and from this point onwards a succession of rapids and two large waterfalls make the river unnavigable for any long distance without a break. The drainage basin of the Orange River is the whole country south of the Witwatersrand enclosed by the escarpment, excepting a small area in Calvinia and Namaqualand. The main stream of that river, which is swelled by many tributaries, rises in the Basuto highlands, and on the coast side of the range countless rivers and torrents struggle through the mountain defiles during the rainy season. But during the greater part of the year when there is no rain many of these rivers are only dry beds. The Vaal River, like the Orange, is not navigable, but has a more varied course, traversing the hilly country made of pre-Karroo rocks around Parys and Venterskroon, and for a distance of over 230 miles it occupies, together with its affluent the Hart's River and the Orange River, the course of an ancient pre-Karroo valley (Kaap), from Vryburg to Prieska. The Limpopo receives the drainage of the northern and middle Transvaal either by gorges cut back through the escarpment or, higher up its course, by the Magalakwin, Crocodile and other rivers which flow northward, describing a semi-circle of nearly 1,000 miles between its source below Pretoria and its mouth above Delagoa Bay.

Climate.— The plateau configuration of the country has the effect of maintaining the climate of South Africa with remarkable uniformity. Thus, Salisbury, in Rhodesia, though within the tropics and 16° nearer the equator, has a mean annual temperature only 2° higher than Cape Town, while the Mossel Bay has practically the same annual temperature as Pretoria and Pietersburg, respectively some 8½° and 10¼° farther north. The mean range between Cape Town and Salisbury is 62.6° and 64.6° Fahrenheit. The mean daily range increases from the coast inwards, averaging slightly over 12° F. at the south coast stations and increasing to over 30° F. in Basutoland and parts of the High Veld, where, however, it is mostly between 26° and 28°. The seasons are the reverse of those in the northern hemisphere, the three warmest months, December-February; the maximum or day temperatures are highest (82.2° F.) in January, and decrease to the lowest (66.3° F.) in June, after which they rise again. The minimum or night temperature curve falls from its highest value (59.1°F.) in February to its lowest point (39.4° F.) in July. The rainfall varies enormously, ranging from over 200 inches in the mountainous district of the southwest of the Cape Province to 2.5 inches at Port Nolloth, and 0.3 at Walfish Bay. In the east of the province the normal annual rainfall is about 62 inches.

Aborigines.— The native races are (1) the yellow-skinned Bushmen and Hottentots, and (2) the various branches of the dark-skinned Bantu. Up to the end of the 18th century the two former races constituted the «native» population, but these are now practically extinct, as separate races, while the Hottentot stock has contributed largely to the population of mixed European and African blood known officially as «colored persons.» The Bantus, after more than a century of wars, have been brought with varying completeness under the control of European officials, and having benefited physically by a modified European system of government, now show a rate of increase slightly higher than that of the European population.

White Peoples.— The original stock of the Boer or Dutch Afrikander people contained a considerable mixture of French blood. The foundation of the predominant white population was laid almost exclusively between 1652 and 1690. The 1687 census showed 573 Europeans, exclusive of the officials and servants of the Dutch East India Company. Immigration records show that the main elements of this parent stock were: (1) the discharged soldiers, sailors and other servants of the company who formed the original settlement in 1657; (2) parties of young women from the public orphanages of Holland, sent out by the company in 1685; (3) a community of Huguenot refugees; and (4) a number of Dutch families. The company took drastic measures from the first to prevent the Huguenots from establishing a separate nationality, and by the middle of the 18th century the French language was forgotten and the refugees incorporated into the Dutch majority, speaking the broken Dutch *patois* known as the *Taal*. With the advent of British rule in 1806 arrived an influx of British officials, soldiers, merchants and missionaries, followed, in 1820, by some 5,000 British immigrants. During the next 50 years many thousands more were poured into the country, and English became the current language over wide areas. Over 2,000 men of the Anglo-German Legion were settled in British Kaffraria; other emigrants came also from central and eastern Europe, and Italy. After the close of the South African War (q.v.) some 2,000 British agricultural settlers were established side by side with the Boer farmers, and employment was found for 3,500 young women, mainly domestic servants, sent from Great Britain by the joint efforts of the government and private organizations.

Religion.— The Dutch Reformed Church and the Third Afrikanshe Gereformeerde Kirk have the largest European membership (700,000 in 1911), the Church of England coming second with some 260,000. Next in strength are the Wesleyans, Presbyterians, Baptists, Congregationalists, Roman Catholics, Lutherans and Jews.

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SOUTH AFRICA COMPANY, British. See BRITISH SOUTH AFRICA COMPANY.

SOUTH AFRICAN REPUBLIC. See TRANSVAAL.

SOUTH AFRICAN WAR, a conflict (1899–1902) between Great Britain and the South African Republic (Transvaal) and the Orange Free State. A considerable body of the Dutch population of South Africa has never been reconciled to the rule of the British, and reasonable grounds for discontent have not been wanting. (See BOERS). The settlement agreed to by Gladstone's government in 1881 after Majuba Hill (q.v.) — followed in a modified form by that of 1884 — was generally looked upon by the Boers of the Transvaal as a triumph for them. «Majuba day» was annually celebrated as commemorating a great event in their history, and this tended to keep alive a spirit of hostility to Great Britain, and perhaps to foster thoughts of a greater triumph that might be attained in the future. The wars with the natives, continued even after 1884, had made the Boers on the whole a military people, and about 1893 President Kruger (q.v.) began to increase the Transvaal armaments, seeing that nothing but force could ultimately keep the Uitlanders—the non-Boer settlers in the Transvaal, especially in Johannesburg (q.v.)—from gaining political rights, and that force would also be necessary to enable him to get rid entirely of British suzerainty, and to secure, what he had long desired, free access to the coast. The Jameson Raid (see JAMESON, SIR LEANDER STARR), an ill-advised attempt made at the close of 1895 by a handful of British subjects, who invaded the Transvaal with a view to gaining some advantage for the Uitlanders — furnished ground for increasing the warlike equipments of the country, and the gold mines of the Rand (see WITWATERSRAND) supplied the funds which were spent on rifles, artillery, ammunition, etc., all of the newest and best types. These funds had to be provided in great part by the Uitlanders, who, though they bore the bulk of the taxation, and owned a great share of the property in the Transvaal, were excluded from any share in the government, and were treated in a harsh and domineering spirit. Early in 1899 a numerously signed petition from British residents in the Transvaal was forwarded by Sir Alfred (now Lord) Milner (q.v.), the high commissioner, to the home government, setting forth the grievances of the petitioners, and declaring their position to have become «intolerable.» It was then arranged, on the invitation of President Steyn (q.v.) of the Orange Free State, that matters should be discussed between the high commissioner and President Kruger at the Free State capital, Bloemfontein. The parties held meetings from 31 May to 5 June, but no agreement was reached. President Kruger now submitted to the Transvaal Volksraad a franchise scheme of his own, professedly meeting all legitimate or reasonable claims of the Uitlanders. To this many of his friends gave their approval, though Sir A. Milner thought it came far short of what was required. Then followed more negotiations, which sometimes seemed to give hope of a satisfactory result; but, apart from the franchise question, the claim of the South African Republic to the status of a perfectly independent state still barred the way to a settlement. Meantime the war spirit was rising in the Transvaal. On 8 September the British Cabinet decided to raise the garrison in South Africa to a strength sufficient to protect the colonies. On 9 October the South African Republic presented an ultimatum, delivered to the British agent in the Transvaal, for answer within 48 hours, demanded that all matters in dispute should be settled by arbitration or in some other way to be agreed on; that all troops on the borders of the republic should be instantly withdrawn; that reinforcements which had arrived in South Africa since 1 June should be removed from South Africa within a reasonable time; and that the troops then on their way to South Africa should not be landed. War at once followed, the Orange Free State, by a previous arrangement, joining the neighboring republic.

The war was actually begun by the Boers invading Natal and Cape Colony, Ladysmith in the former and Kimberley and Mafeking in the latter being the places in which the greatest interest was almost immediately centred. At the beginning of the struggle the British regular troops in South Africa did not greatly exceed 22,000 in number, about half of them being in Natal under the command of Sir George White, who had his headquarters at Ladysmith. On 20 October the Boers who had invaded northern Natal endeavored to cut off the British camp near Dundee, where General Symons was stationed with about 5,000 men. They were repulsed at Talana Hill, but the British general was mortally wounded; and the following day they were more severely defeated at Elandslaagte by General Franch's force from Ladysmith. It was necessary, however, to withdraw the northern garrison to Ladysmith, and this was done — after the Boers had been beaten off by General White at Rietfontein. The Boers were now in such force that (with General Joubert as commander-in-chief) Ladysmith was soon completely invested, the railway from the south being seized, as well as the bridge over the Tugela at Colenso. Several naval guns had been brought into Ladysmith before this, which enabled its defenders to reply to the powerful artillery which the Boers had planted on the neighboring heights. Swarming down into Natal the invaders overran the country as far as the Mooi River and beyond, and it appeared that they might even attack Maritzburg; but the first army corps of 54,000 men reached South Africa in November, and Gen. Sir Redvers Buller, who had arrived to take supreme command, took under his charge a large portion of this force, and so was able to drive the Boers back and prepare for the relief of Ladysmith. Other divisions of the reinforcements were dispatched inland from Cape Town, Port Elizabeth and East London to aid in checking the Boer advance into Cape Colony, and to open the way to Kimberley. The force which undertook the latter task was under the command of Lord Methuen, while General Gatacre was to operate against the Boers in the Stormberg district of the Cape Colony, French being in command of a British force between the two. Advancing northward, Methuen assumed the offensive, drove the Boers from a strong position at Belmont, defeated them two days after at Enslin, and on 28 November dislodged them from a strong position at the Modder River, which was crossed without opposition. Then followed a series of reverses to the British troops, which cast a gloom over the whole empire.

On 10 December Gatacre attempted a night attack on a body of Boers strongly posted near Stormberg, but after a toilsome night march his men unexpectedly came upon the enemy's position, which they were unable to capture, and were driven back with heavy loss. On the same day General Methuen had shelled the Boers previously to attacking their position at Magersfontein, where, as at many places afterward, the Boer general De la Rey (q.v.) distinguished himself. Early next morning, while marching to the attack in quarter column, and on the point of deploying the Highland brigade unexpectedly found itself exposed to a close fire from the Boer trenches and lost very heavily, the commanding officer, General Wauchope, being killed. The third and most serious reverse took place in Natal. On 15 December General Buller attempted, by what has been generally regarded as an ill-judged plan, to force his way across the Tugela at Colenso, with the view of relieving Ladysmith. This great mistake consisted in attacking two days earlier than arranged for with White, who remained inactive in Ladysmith without knowing what was going on outside. It has not been explained why Buller did not advise White of the change in his plans. Notwithstanding a display of admirable courage on the side of the British, and certain partial successes, the plan as a whole entirely failed, the failure being aggravated by casualties in killed, wounded and missing amounting to over 1,100, while 10 superior guns were abandoned to the Boers. The only son of Lord Roberts (q.v.) fell at Colenso.

On receiving the news of General Buller's repulse, the Cabinet decided to send out immediately the seventh army division already being mobilized, to call up the remainder of the army reserve, to incorporate a new yeomanry force, to allow 12 battalions of militia to volunteer for service abroad, to employ volunteers on active service, and to accept offers of help made by the great colonies. Lord Roberts was instructed to proceed to South Africa as commander-in-chief, with Lord Kitchener as chief of his staff; and Col. Hector Macdonald was appointed to succeed General Wauchope in command of the Highland brigade.

When the year 1900 opened, the troops hemmed in at Ladysmith, Kimberley and Mafeking were holding their own, but at the first place enteric fever had begun to make serious ravages, and to cause much anxiety. In the Cape Colony Methuen was confronted by General Cronje in a strongly intrenched position; and Gatacre, after falling back from Stormberg, was holding Sterkstroom. French in the Colesberg district was more actively employed, and succeeded in defeating the Boers in several important actions. Lord Roberts and his staff arrived at Cape Town on 10 January, but before anything could be done by the new commander-in-chief, Buller made another attempt against the Boer position at Colenso (11 January). With this unsuccessful movement is associated the name of Spion Kop, an eminence in the scene of action the seizure and temporary occupation of which cost many British lives to no purpose. Yet a third attempt was made to break through to Ladysmith (5 February), Vaal Krantz being a position which figured most prominently on this occasion; but again the result was only disappointment, to the besieged force more especially. Meanwhile Roberts had been making plans for more effectively dealing with the enemy, and had collected a strong cavalry force under French between the Orange River and the Modder. While the attention of the Boers under Cronje was drawn off by a movement carried out by Macdonald and the Highland brigade, French advanced rapidly on Kimberley and, in spite of all opposition, reached the place, dispersed the investing troops, and entered the town (16 February). Cronje at Magersfontein had now allowed himself to get into a difficult position, not fully realizing the strength and intentions of the British, and though he tried to escape eastward toward Bloemfontein, it was too late. He was brought to a halt at Paardeberg, took refuge in the bed of the Modder, where he managed to hold out for a week, but being completely hemmed in, and an attempt at his rescue by General De Wet being defeated, he surrendered to Roberts with over 4,000 men. This was on 27 February, the anniversary of Majuba Hill. Cronje and the rest of the prisoners were sent to Saint Helena. Meanwhile fresh efforts were being made by Buller for the relief of Ladysmith, and this time with success. After a series of difficult operations, the Boer left was finally turned, and on 28 February Lord Dundonald rode into Ladysmith, being followed by Buller two days later. The garrison was found to be in sore straits for want of food, and had suffered severely from disease as well as from the attacks by which they had been harassed. One of the fiercest of these had been made on 6 January, when the Boers had endeavored to take the town by storm, but were repulsed with heavy loss. On this occasion a position known as Wagon Hill had been three times captured and recaptured in the course of the day, Gen. Ian Hamilton (q.v.) here greatly distinguishing himself. It has been said that «the successful defense of Ladysmith was from a military point of view the most valuable achievement of the war, inasmuch as the loss of a garrison of 12,000 men would have been a graver disaster than any conceivable defeat in the open field; and, moreover, the fall of Ladysmith was to be the signal for the general rising of the Dutch in the Cape Colony and Natal.» Following on the successes in the west of the Orange Free State came successful operations by the generals in the northern parts of Cape Colony — Gatacre, Clements and Brabant. Bloemfontein now became Roberts' objective, and after Joubert had vainly attempted to bar his way at Poplar Grove, and again at Driefontein, the British commander entered the capital of the Orange Free State practically without opposition (13 March). Kruger and Steyn fled to the north. The keys of the town were surrendered to Lord Roberts, and the railways being soon repaired, through communication was opened between Bloemfontein and Cape Town. The Orange Free State was proclaimed British territory.

There was a long halt at Bloemfontein, and during this period enteric fever proved a terrible scourge to the British, and the Boers were encouraged to fresh activity. Several mishaps now befell different bodies of British troops, and De Wet proved himself a leader of exceptional ability on the Boer side, while Louis Botha (q.v.) also gained distinction for himself, having succeeded to the chief command on the death of Joubert (27 March). The advance northward from Bloemfontein began on 3 May. The British forces under Gens. Ian Hamilton, French and Pole Carew, with Lord Roberts at their head, often showed a front of 40 miles, and though the enemy repeatedly seemed to threaten a determined stand, no effective resistance was encountered, either on the Vaal or elsewhere. One after another the Boer positions were turned; Botha's troops fled in confusion from Johannesburg, where the British flag was hoisted on 31 May, and Pretoria, the Transvaal capital, was occupied on 5 June, no attempt being made by the Boers to hold the forts. General Botha and a considerable body of men retired eastward along the railway in the direction of Komati Poort, near the Portuguese frontier, in which direction President Kruger, Mr. Reitz and other members of the Transvaal government had preceded him. The Boers were followed and beaten at Pienaar's Poort, about 15 miles from Pretoria. Meanwhile Buller had been advancing northward through Natal, and had entered the Transvaal from that side, driving the Boers before him. On 15 May Dundee and Glencoe were retaken, on the 17th Newcastle, and by the end of the month he was encamped within striking distance of Majuba and Laing's Nek, which were strongly held by the enemy. But by a skilful turning movement General Hildyard secured command of the Boer positions, which were at once evacuated. Buller's force had marched 50 miles in six days, and had defeated the Boers in four engagements. His troops were thus put in a position to co-operate with the main army under Lord Roberts, and early in July the railway to Pretoria from Durban was open. The number of British troops in South Africa by the middle of the year was about 250,000.

Shortly after the middle of May (1900) news reached England that the Boers had been driven from Mafeking, and that the town had been entered by a British force from the south. The place had been invested from 15 October, when Cronje with a force of some 9,000 men had marched to the attack. It was well supplied with stores, and this, together with the indomitable energy and fertility of resource shown by Major-General Baden-Powell, who commanded the small garrison, enabled it to hold out against all attempts to capture it. A last attempt to take it had been made on 13 May by Commandant Eloff, a grandson of President Kruger. This not only failed, but the leader and a number of his men were themselves taken prisoners.

In the end of July an important success was gained in the Orange Free State (now called Orange River Colony) by General Hunter, with the aid of Generals Rundle, Clement, Bruce-Hamilton, Paget and Macdonald. As the result of a combined movement, a force of some 4,000 Boers under Prinsloo was surrounded by the British troops and forced to surrender with guns, horses and wagons, the burghers being sent as prisoners to Ceylon. De Wet, with 2,000 men, escaped, as on various subsequent occasions.

Advancing eastward from the Pretoria district Roberts joined hands with Buller, and from his headquarters at Belfast issued a proclamation annexing the Transvaal to the British dominions (1 September). Previous to this Buller had forced the Boers from a strong position they had taken up near Machadodorp, and had thus effected the release of a large number of prisoners whom they had taken with them from Pretoria.

On 11 September President Kruger took refuge in Portuguese territory, and many of his compatriots followed his example, or scattered in different directions, having previously destroyed many of their guns, with vast quantities of ammunition and stores. Lord Roberts reported that there was nothing left of the Boer armies but a few marauding bands, but this view of the case proved premature. On 6 October Buller left the army for England; on the 20th President Kruger sailed for Europe on board a Dutch man-of-war. Lord Roberts left for home before the end of the year, handing over the chief command to Lord Kitchener.

The war had now entered upon what might be called the guerrilla stage, during which the activity and daring of such leaders on the Boer side as Botha and De Wet gave plenty of hard work to the British troops. Looking with confidence for support from their kinsmen in the Cape Colony and Natal, and still hoping for the intervention of some European power, the Boer leaders planned two enterprises which they thought might yet retrieve their cause. Botha, with some 6,000 men, was to make a sudden dash into Natal and raid the country, if possible, all the way down to Durban, while De Wet was to execute a similar movement in the direction of Cape Town. These attempts were made in the early part of 1901. Botha's plan was completely frustrated by a great sweeping movement of General French; the Boers were dispersed with the loss of guns, wagons and immense numbers of cattle and sheep. De Wet fared no better but, like Botha, he himself escaped capture, though losing guns, ammunition and wagons. Marauding bands that had belonged to his force managed, however, to enter the Cape Colony, and for a time gave much trouble, aided and encouraged as they were by their Dutch friends. To checkmate the Boer system of warfare Kitchener resolved to clear the country of food and cattle so as to deprive the Boers of supplies, to protect the railways by chains of blockhouses, to carry similar chains across the country in suitable directions, and to keep the Boers perpetually on the move by mobile columns of British troops. Kitchener's measures, which were found exceedingly effective in the long run, included the gathering together of great multitudes of Boer women and children into the so-called concentration camps, a measure widely discussed and much condemned in the press of neutral countries.

A discussion regarding terms of peace took place between Lord Kitchener and General Botha on 28 March 1901, but nothing came of it; the gradual wearing down of the Boers went on, and by the end of May they had lost practically all their artillery (apart from guns buried in the earth). On 12 July the Free State government and some important papers were captured at Reitz, and President Steyn himself made a narrow escape. On 7 August Kitchener issued a proclamation calling for the surrender of the Boers by 15 September, on pain of the perpetual banishment of the leaders, and of the property of the others being charged with the cost of maintenance of their families in British hands. The Transvaal and Free State leaders had been discussing the advisability of giving in, but President Kruger, from Europe, urged them to continue fighting until their independence was secured. Renewed activity on the part of Botha, De Wet and other Boer leaders followed, and the British met with one or two rather serious mishaps. By the end of the year 1901 there had been put out of action some 53,000 Boers, of whom 40,000 were in concentration camps or were kept in custody in Saint Helena, Ceylon, India, Bermuda or elsewhere. After some great «drives» organized by Kitchener and carried out in the early part of 1902, which resulted in the surrender of many burghers, and which owed their success largely to the blockhouse system, negotiations for peace were at last entered on (23 March), though military operations were not suspended. The Boer leaders were granted facilities for meeting and discussing matters among themselves and with the different commandoes, and after this had gone on for some time, on 15 May a conference of Boer representatives met at Vereeniging to consider terms of surrender. Among those present were Botha, Beyers, Smuts, De Wet and Delarsy. It was not until the last day of the month, however, that peace was absolutely secured, the surrender being signed at Pretoria by Lords Kitchener and Milner and the chief civil and military representatives of the Boers, and the war thus brought to an end. After over two-and-a-half years' war the whole of South Africa, from Cape Town to the Zambesi, had been added to the British Empire. The main points agreed upon were: that the Boer forces would immediately lay down their arms and hand over all guns, rifles and munitions of war; that burghers in the field outside the Transvaal and Orange River Colony, and all prisoners of war outside South Africa, on declaring their acceptance of the position of subjects of Edward VII, should be brought back to their homes as soon as transport could be provided and their means of subsistence secured; that no proceedings civil or criminal should be taken against burghers so surrendering or returning, for acts done in connection with the war, unless as regards acts contrary to the usages of war; the Dutch language to be taught in public schools where parents desire it, and to be allowed in courts of law; the possession of rifles to be allowed to persons requiring them for protection, on taking out a license; military administration to be succeeded as soon as possible by civil administration, and ultimately representative institutions and self-government; a sum equal to $15,000,000 to be granted for the purpose of assisting in the restoration of the people to their homes, besides advances on loan free of interest for two years. These terms were practically the same as those rejected by Botha 13 months earlier.

In this struggle there had been engaged on the British side at one time or another, or sent to the seat of war as reinforcements, from the outbreak of war until the conclusion of peace, 448,435 men of all arms, including 228,171 regulars, 45,566 militia, 35,520 yeomanry, 19,856 volunteers, 7,273 South African constabulary, 18,229 regular troops from India, 29,000 colonial contingents, 52,414 raised in South Africa. Of these 518 officers and 5,255 men were killed, 1,851 officers and 20,978 men were wounded, 554 officers and 15,617 men died of wounds or disease. How many men the Boers had in the field from first to last, including the rebels belonging to Cape Colony and Natal, will probably never be known. The number has been estimated by competent authorities at 60,000 to 65,000. The Boer casualties have never been definitely ascertained.

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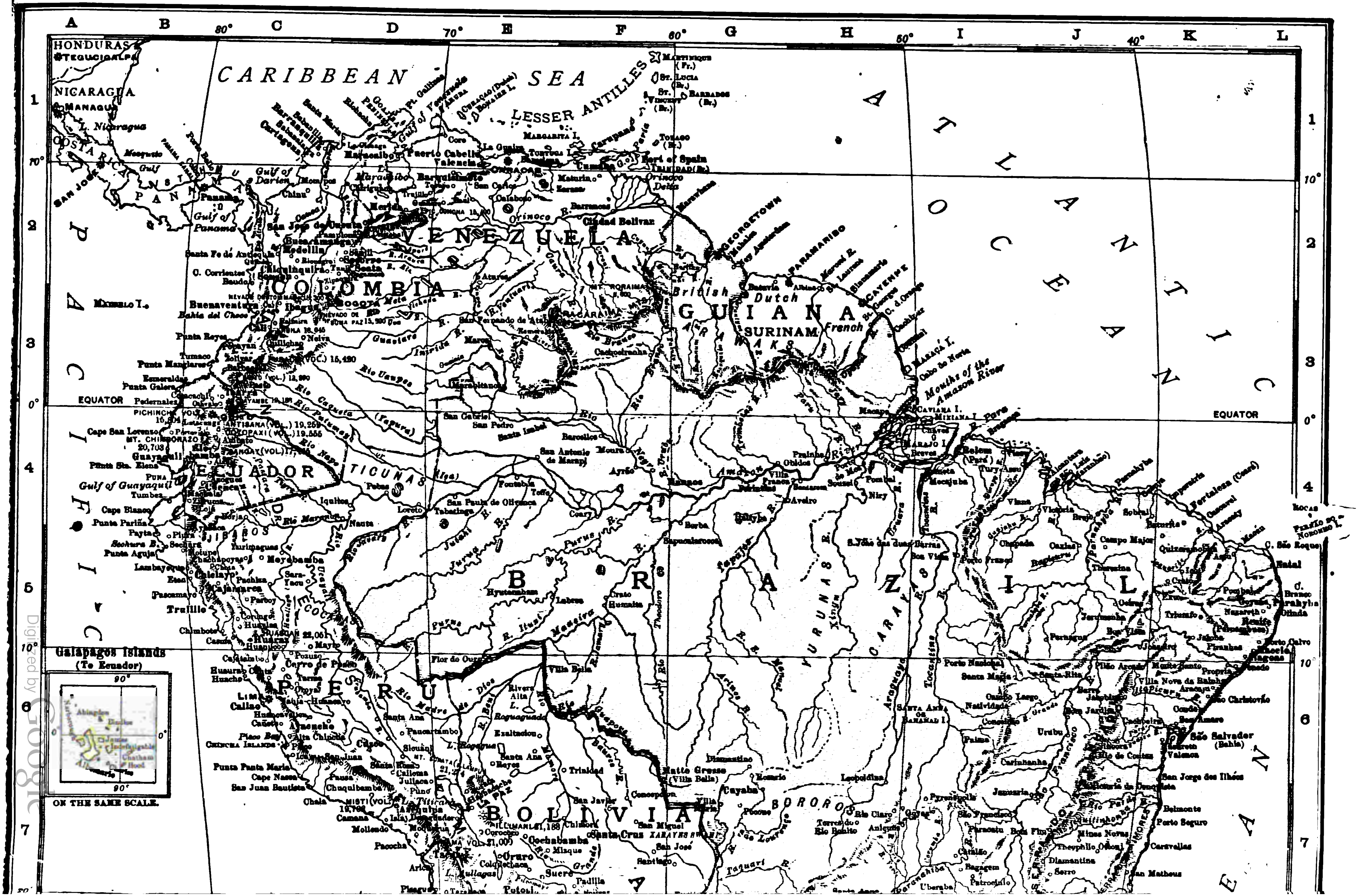
SOUTH AMBOY, N. J., borough in Middlesex County, at the mouth of Raritan River and the head of Raritan Bay, and on the Pennsylvania, the Central of New Jersey and the Raritan River railroads, 20 miles south of Newark. It was founded in 1835 and became a borough in 1888. It is important as a shipping point for coal, and has terra-cotta works, clay and sand pits and asphalt works. The most notable public building is the borough hall; and there are two public schools and a Roman Catholic parish school. The government is vested in a mayor and a council of six; two members of which are elected each year for a term of three years. Pop. about 7,007.

SOUTH AMERICA, a continent the estimated area of which is, in round numbers, 7,300,000 square miles with an estimated population of 57,000,000 in 1919. It is joined to Central America by the Isthmus of Darien, the boundary-line between Colombia and the Republic of Panama being taken as its limit on the northwest. The westernmost point on its Pacific Coast is directly south of the peninsula of Florida; both the extreme northerly point, projecting into the Caribbean Sea, and, at the extreme south, the archipelago of Tierra del Fuego, adjoin long. 70° W., which is also the longitude of Cape Cod, Massachusetts. Thus, its Pacific Coast and one-half of its Caribbean Coast lie due south of the Atlantic Coast of the United States. Moreover, only a relatively small part of the great equatorial land-mass between lat. 10° N. and lat. 25° S. is west of longitude 70°. The Atlantic coasts form an enormous angle reaching so far toward the east that sailing distances between Pernambuco and some of the European ports are practically equal to the sailing distance between New York and the same Brazilian city. In reality, then, South America, from the point of view of inhabitants of the United States, is Southeastern America.

For the varied purposes of social intercourse and commerce, therefore, its eastern coasts below the equator are as readily reached from Europe as from the great centres of population in the United States; and before the Great War this virtual equality in geographic situation was converted into marked advantage for Europeans by the superior facilities for transportation and direct intercommunication between Europe and the especially important South American Atlantic ports, to say the least,— an advantage which was accentuated, so far as it concerned the nations of southwestern Europe, by ancient association, force of habit and essential community of tradition and language. The results were that a large part of the southeastern continent, while developing distinctively New World characteristics in many ways, still constantly received formative ideals and manners, culture and its fashions, from West-European sources, and of course bestowed its trade in the same quarter. For studies of other causes which tended to produce similar effects, and for an account of changes wrought during the World War, see LATIN AMERICA.

Since the war ended, phases of readjustment to changed conditions in foreign relations, or of new developments in time-honored American connections, have naturally been most in evidence; and of such phases there are three which deserve special mention: First, a movement the aim of which is to promote the peace and progress of the Western Hemisphere and to confirm Pan-American solidarity (compare Special Memorandum: *American Questions and the Monroe Doctrine,* issued by the Pan-American Union, Washington, April 1919); second, the admirable quality of the views expressed, and confirmed by resolution, in the First American Congress of Economic and Commercial Expansion, which was held at Montevideo, official representatives from all South American republics being in attendance, and which advocated the establishment of colleges or departments of economic expansion in colleges and schools, to the end that "the study and practical solution of economic problems may be intensified in the effort to cement Pan-America commercial friendship"; third, the actual state of foreign trade as between the United States and South America, an estimate by the National City Bank of New York showing, for the fiscal year 1919, imports from South America gaining about 150 per cent, compared with those of 1914; exports to South America about 225 per cent; the total trade of the United States with South America, including both imports and exports, which amounted only to $345,000,000 in 1914, being estimated by the same authority at $1,000,000,000 in 1919.

The South American republics are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela. Dependencies of European countries on the mainland are the three Guianas — British, Dutch and French. The Falkland Islands, which are included in the foregoing estimates of area and population, are British. For information in regard to each of the South American countries — its area, topography, mineral resources, agriculture, manufactures, weights and meas-


CARIBBEAN SEA
ATLANTIC OCEAN
PACIFIC
LESSER ANTILLES
HONDURAS
Tegucigalpa
NICARAGUA
Managua
L. Nicaragua
COSTA RICA
San José
PANAMA
Panama
Gulf of Panama
Gulf of Darien
VENEZUELA
Caracas
Maracaibo
Puerto Cabello
Valencia
La Guaira
Ciudad Bolivar
Orinoco R.
Port of Spain
Trinidad (Br.)
Tobago (Br.)
Barbados (Br.)
Martinique (Fr.)
St. Lucia (Br.)
St. Vincent (Br.)
Margarita I.
Curaçao (Dutch)
Bonaire I.
Aruba
COLOMBIA
Bogota
Medellin
Cartagena
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Santa Marta
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Cali
Popayan
Pasto
Malpelo I.
BRITISH GUIANA
Georgetown
DUTCH GUIANA
SURINAM
Paramaribo
FRENCH GUIANA
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Quito
Guayaquil
Gulf of Guayaquil
Equator
Chimborazo 20,703
Cotopaxi (Vol.) 19,550
Antisana (Vol.) 19,259
Pichincha (Vol.) 15,604
TICUNAS
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L. Titicaca
JIBAROS
BOLIVIA
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Oruro
Potosi
Santa Cruz
BRAZIL
Amazon R.
Rio Negro
Madeira R.
Purus R.
Manaos
Pará (Belem)
Marajo I.
Mouths of the Amazon River
Cabo do Norte
Maracá I.
Caviana I.
Mexiana I.
Santarem
Obidos
São Luiz (Maranhão)
Fortaleza (Ceará)
Natal
Parahyba
Recife (Pernambuco)
Maceió
São Christovão
São Salvador (Bahia)
C. São Roque
Rocas
Fernão do Noronha I.
Tocantins R.
Araguaya R.
Xingu R.
São Francisco R.
Matto Grosso (Villa Bella)
Cuyabá
BORORO
YURUNAS
CARAYAS
Galápagos Islands (To Ecuador)
ON THE SAME SCALE
Albemarle
Narborough
Abingdon
Indefatigable
Chatham
Hood
A B C D E F G H I J K L
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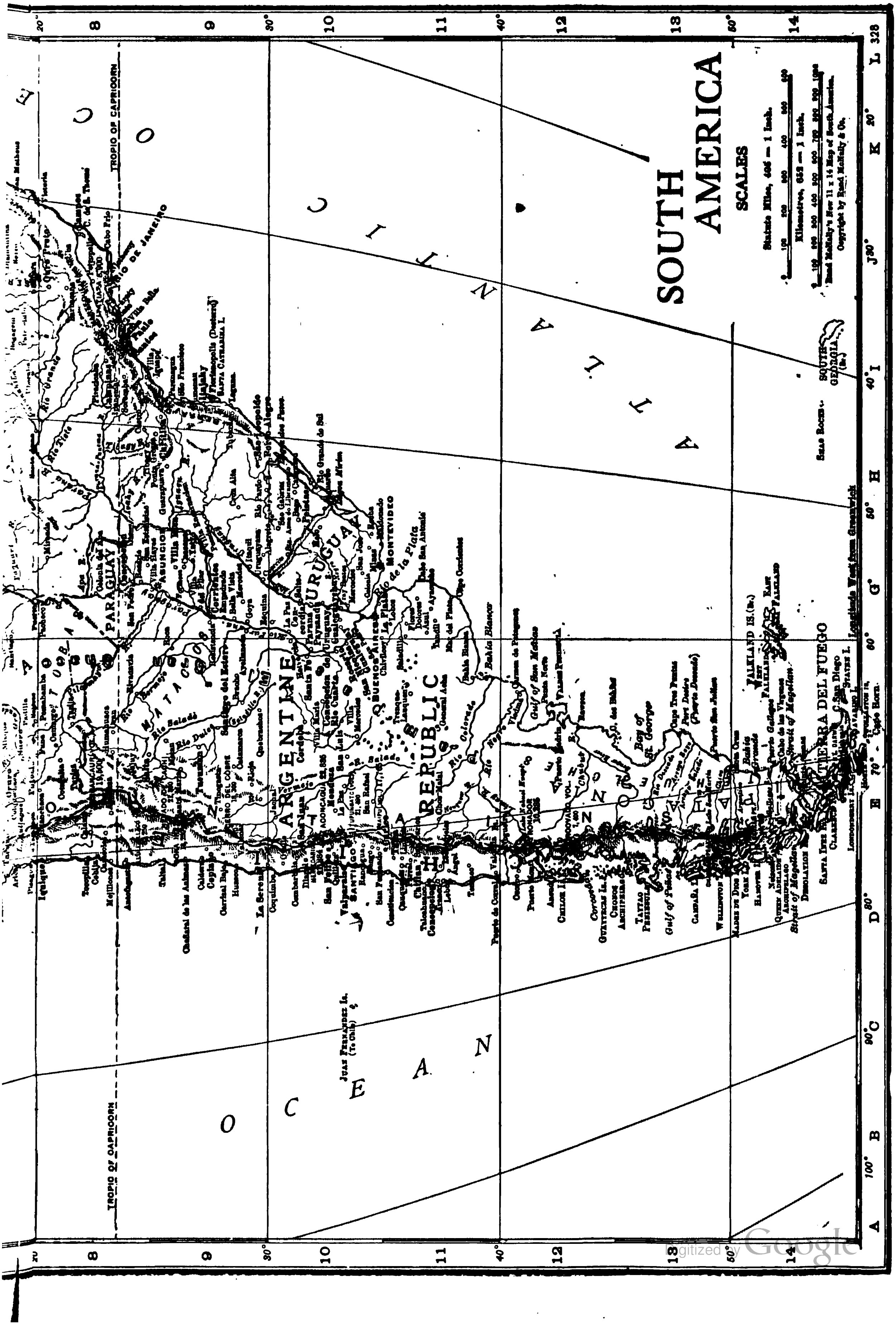
SOUTH AMERICA
SCALES
Statute Miles, 495 — 1 Inch.
Kilometres, 658 — 1 Inch.
Rand McNally's New 11 x 14 Map of South America.
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OCEAN
TROPIC OF CAPRICORN
ARGENTINE REPUBLIC
PARAGUAY
URUGUAY
TIERRA DEL FUEGO
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SOUTH GEORGIA (Br.)
Longitude West from Greenwich
RIO DE JANEIRO
SAO PAULO
ASUNCION
MONTEVIDEO
BUENOS AIRES
SANTIAGO
Valparaiso
Rio de la Plata
Bay of St. George
Gulf of San Matias
Strait of Magellan
Cape Horn
Staten I.
Juan Fernandez Is. (To Chile)
Iquique
Antofagasta
La Serena
Coquimbo
Concepcion
Puerto Montt
Chiloe I.
Cordoba
Rosario
Mendoza
Tucuman
Bahia Blanca
Rio Colorado
Rio Negro
Rio Salado
Rio Bermejo
Rio Pilcomayo
Paraná
Uruguay R.
Falkland Sound
ACONCAGUA 22,868

ures, money, banks, government (including the judiciary and the departmental, state or provincial governments), army and navy, finances (revenues, expenditures and public debt), foreign and domestic commerce, population, immigration, transportation, climate, flora and fauna, educational system, religion, history, literature and art, bibliography, etc.— see the articles devoted to the country in question, to its chief cities and political divisions; also the articles under the general caption Latin America. Important geographic features are described at greater length in separate articles, e.g., ANDES, and such features also form a part of the wider survey in the article AMERICA. For lists of standard works on South America, the reader is referred to bibliographies appended to the articles mentioned above.

MARRION WILCOX.

SOUTH AMERICA, American Diplomatic Relations with. In 1783 the future influence of the new-born American republic upon Spanish America was foreseen by the apprehensive Spanish Prime Minister, Aranda. Three years later Gordoqui, the Spanish Minister to the United States, reported that Americans would probably form an establishment on the Falkland Islands to which many American vessels had gone fishing in 1784 and 1785.

In 1787 American vessels sailing from Boston for the west coast stopped at the island of Juan Fernandez in direct violation of the Spanish restrictive order of 1782 which forbade foreign ships to navigate the South Seas without the permission of Spain. In 1790 other American vessels stopped at the Lobos Islands. Thereafter, in spite of the alarm of Spanish officials, a steadily increasing number of vessels contributed their influence to the development of new ideas along the Pacific Coast. By 1798 Salem merchants began with Cayenne a trade which rapidly pressed eastward along the Brazilian Coast. In 1799 American trading vessels (from Philadelphia) first reached Montevideo. By 1801 others (from Boston and Providence) first opened direct trade with Buenos Aires. American trade thereafter both with Brazil and with ports of the Plate rapidly increased. In 1803, when Spain complained that American vessels had participated in the fishery of sea dogs on the South American Coast, Secretary Madison, by direction of Jefferson, replied that Spain was not expected to controvert nor interrupt the «rights of American citizens to navigate and use the seas.»

Through efforts of business men and whalers ideas of republicanism and independence were introduced. As early as 1798 leading Americans were attracted by the schemes of Miranda for inaugurating a revolution in Spanish America. In 1806, even before the British expedition of that year against the Plate territory of Buenos Aires, adventurous Americans participated in an ill-timed and unsuccessful expedition against Venezuela which Miranda equipped at New York under the representation that he had the secret sanction of the American government at Washington.

In the Spanish-American Revolution which began in 1810, the American government took a live interest illustrated in the prompt appointment of consular (or political) agents; but, in the face of strong suggestions or invitations for «fraternal alliances which would unite the Americas forever,» it maintained an impartial neutrality, opening its ports equally to both parties and restraining its citizens from interfering in favor of either belligerent (although the American agent J. R. Poinsett directed the Chilean army in a successful attack against the Peruvian forces in 1813). In 1815 William Thornton, a friend of the three early Virginian presidents, published a plan which he had advocated 15 years earlier, in favor of extending the republican system over all the Americas, and the adjacent islands — 13 sections with distinct governments but united by one general government at the «City of America» on the Isthmus of Darien across which a lock canal was to be constructed from sea to sea. In 1815 President Monroe issued a neutrality proclamation, and in 1817 Congress enacted a neutrality law, which, amended in 1818, established a higher standard of national obligation.

In 1818 President Monroe received a tempting proposition for separation of all Spanish America from Spain and the establishment of its freedom under the protection of the United States which under the plan was to extend its territorial limits to the Isthmus of Panama.

Finally, in March 1822, yielding to an obligation of duty, President Monroe recommended the recognition of Venezuela, Chile, Colombia and La Plata provinces as independent states — a fact practically admitted by Spanish official negotiation with the insurgents and enforced by the absence of adequate Spanish forces to dispute it. On 17 June he received a regular diplomatic agent from Colombia (Don Manuel Torres). In January 1823, under act of May 1822, he appointed ministers to Argentina, Chile and Colombia, and in December 1823 issued the famous expression of policy against forcible intervention by a combination of European powers to restore Spanish dominion over the new republics. On 3 Oct. 1824 the American government concluded with Colombia at Bogotá the first American treaty with a Latin-American republic — the first of a long series of treaties of amity and commerce with the republics, and containing liberal provisions for the abolition of discriminating duties and remained in operation until 1836. In May 1826, it recognized the independence of Peru which had recently been successful in obtaining the surrender of Callao, the last Spanish fortress in South America. In 1825 and thereafter both by direct representation at Madrid and by solicitation of the co-operation of other European powers, it sought to induce Spain to recognize the government of the new republics created from her former provinces and in September 1834 it finally obtained a decision in favor of negotiations to that end. In 1825 it recognized the independence of Brazil which had been proclaimed in 1822 and established by force a year later.

Still in fear of Portugal and under a misapprehension of the meaning of the Monroe Doctrine, Brazil sought an alliance with the United States which secretary Clay courteously declined. In July 1824 Colombia also inquired whether the United States would agree to enter into a treaty of alliance to save the Americas from a calamity of the despotic system, but Jefferson advised

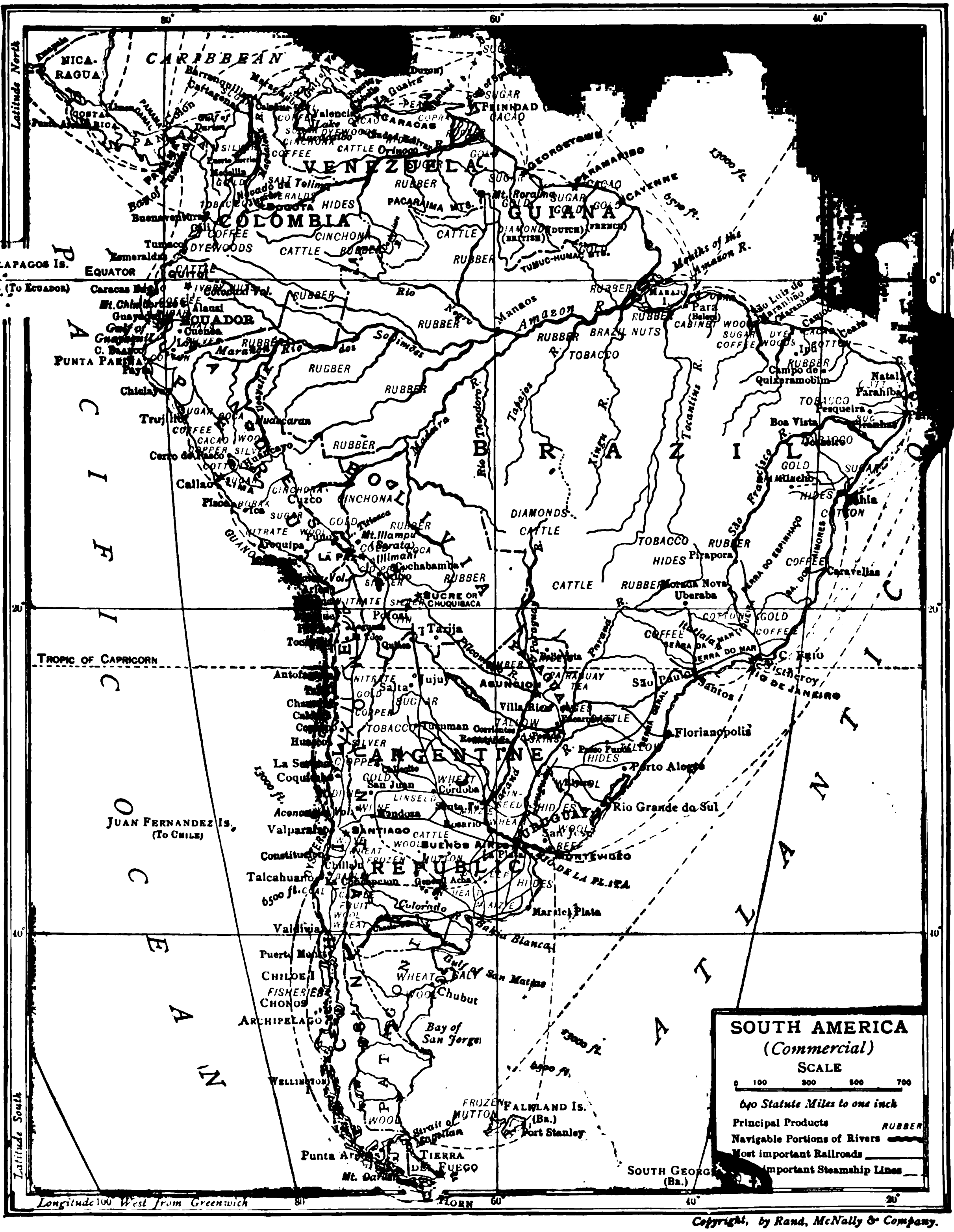
Monroe to reply that the United States could not protect them without concurrence of England. In 1826 in response to the invitation of Colombia and Mexico, the American government sent delegates to the Panama Congress of American plenipotentiaries called by Bolivar's famous circular of 7 Dec. 1824; but, owing to delay caused by the disapproval of the American senate, the delegates failed to reach Panama in time for the Congress, thus disappointing Latin-American expectations. Whatever plans may have been conceived by the Adams administration for American hegemony of the American continent (as suspected by Canning) were weakened by the publicity which the Panama debate gave to American racial prejudices and by contemporary American protests against the proposed Colombian-Mexican attack on Cuba.

In 1825–26, the possible need of a more competent naval force on the west coast (to protect American commerce from possible piracy which might result from the unsettled condition of South American governments) first attracted the attention of the American government to the need of a trans-isthmian passage at Panama which was again considered in 1835 (when Charles Biddle without proper authority of President Jackson went to Panama and obtained a canal concession which his government declined to accept) and finally resulted in a transit treaty with New Granada in 1846.

In 1831 a long dispute with Argentina arose through the American destruction of an establishment which the government of Buenos Aires had made on the Falkland (or Malavinas) Islands, afterward (1833) effectively occupied by Great Britain under a claim of title asserted and maintained for 60 years. To the unsettled shores of these islands American citizens engaged in whale and seal fisheries had resorted for shelter and necessary supplies without molestation for more than 50 years, and they objected to the seizure of their vessels in 1831 and imprisonment of crews at Soledad by one Vernet who claimed to act under an indefinite decree issued by Buenos Aires on 10 June 1829. The American government, regarding Vernet's acts as lawless and piratical, promptly asked Buenos Aires for a disavowal and sent a naval vessel which deported Vernet and his followers to the shores of Uruguay. Following the demand of the Argentina government for reparation, Mr. Baylies, the American chargé, demanded his passports, resulting in a severance of diplomatic relations for several years. In 1841 General Alvear at Washington pressed claims for indemnity which Secretary Webster declared must await the final settlement of the British-Argentine controversy over the right of jurisdiction to the islands. The long-dormant claim of American liability was revived in 1883–85 and pronounced by the American government as wholly groundless because of the derelict condition of the islands which justified the act of the American naval officer.

After 1840 the increasing importance of closer relations with South America was recognized. As early as December 1842 the American government received information of a proposed Lima Congress of Latin-American states (Argentina, Peru, Bolivia, New Granada, Brazil and Mexico) to sustain the dominant parties in those states and to oppose the advance of the United States on the American continent. In 1845 Argentina and other South American governments were disappointed in their hopes of active interference of the American government against the Anglo-French blockade of the coast of Buenos Aires, resulting from Brazil's invitation of 1844 for their intervention to protect the independence of Uruguay which had been recognized by a treaty of 1828 signed both by Brazil and by Buenos Aires. The American government, satisfied with assurances obtained from the British government and apprehensive of no danger from temporary European intervention, decided to remain neutral. In 1844 for protection of American interests it sent a small fleet which offended the Argentina government by seizure of vessels of the Argentina squadron — an act which was promptly disavowed. Later, in March 1846, Secretary Buchanan, stating that the moral influence of the United States was in favor of Argentina, instructed the American Minister at Buenos Aires to report promptly any British-French activities indicating territorial designs. In June 1845 Edward A. Hopkins was appointed "special agent" to Paraguay to obtain information with a view to possible recognition of its independence, but in 30 March 1846, largely from regard to Argentina, he was peremptorily recalled for exceeding his authority by his diplomatic negotiations with Paraguay in favor of recognition and by an offer of mediation between the governments of Paraguay and Buenos Aires in favor of Paraguay which by league with Corientes against Argentina would have become the ally of England and France in their designs. Fortunately the perplexing question presented to the American government by participation of European powers in La Plata affairs was finally settled by discontinuance of the blockade, first by England and soon thereafter by France. In 1850 the American Minister at Buenos Aires in reply to a hypothetical question dispelled the illusion of General Rosas that the United States would aid Argentina to resist France in case of war. In 1846 serious complications were threatened by disturbances at Panama, across which communication became very important to the United States, and by a projected expedition of General Flores (formerly president of Ecuador) against Ecuador — an expedition which was supposed to have for its purpose the creation of monarchies in the new world. Two years later, Venezuela, fearing British designs of annexation along the Guiana border as a result of British activities there since 1841, turned to the United States in hope of an alliance. At the same time new dangers of disorders were threatened by a territorial quarrel between Peru and Bolivia.

In order to secure a more satisfactory transit treaty of isthmian transit than the arrangement which had been negotiated in 1844, the American government concluded a treaty in 1846 providing for equality of use of the transit route for the commerce and citizens of both countries under American guarantee, really establishing an American protectorate



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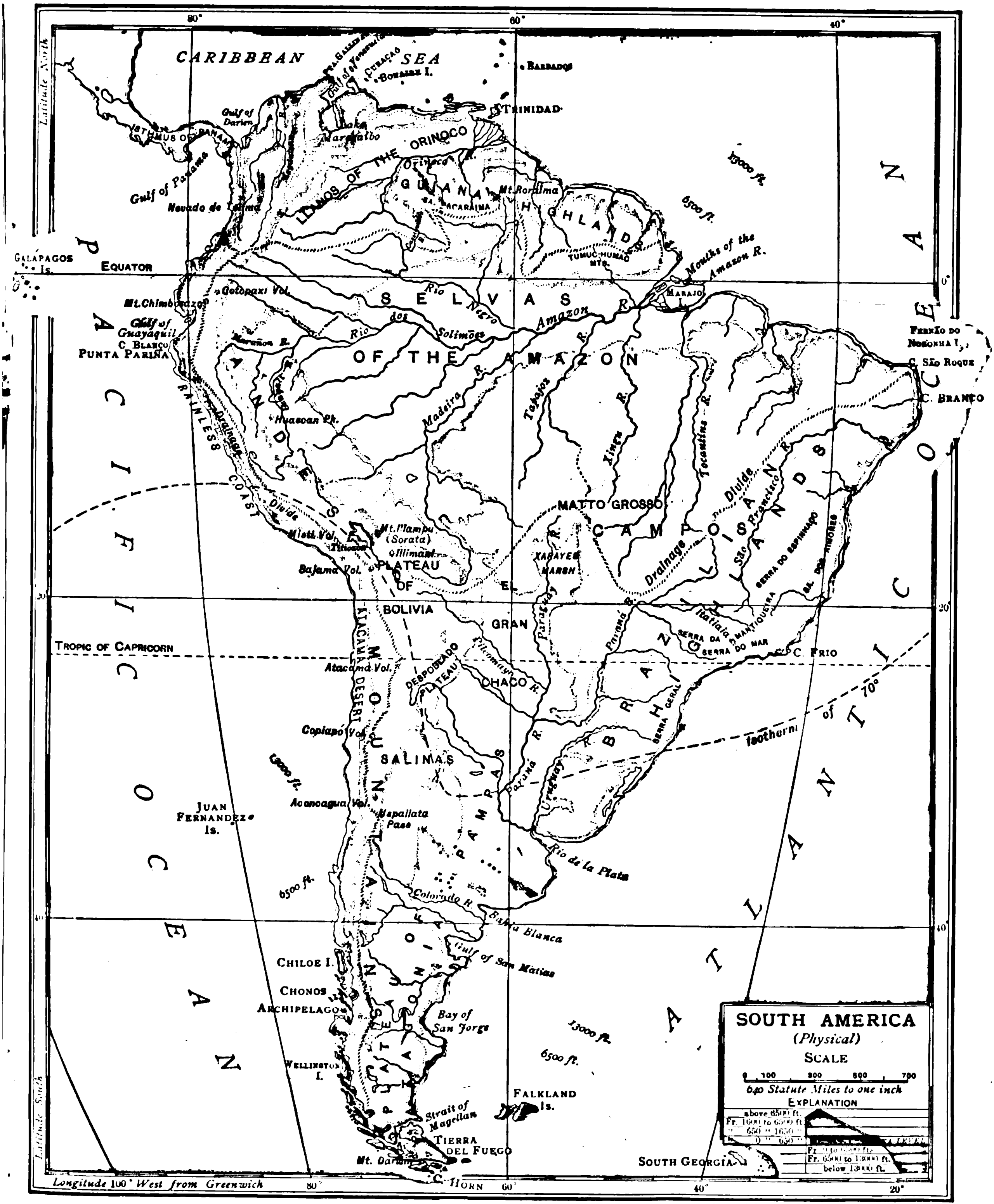

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over the isthmus, but for a commercial purpose in which all the world had a common interest, and with expectation of similar guarantees by Great Britain and France. It became effective on 10 June 1848. In 1847 in reply to invitations for protection against the apprehended Flores expedition, Secretary Buchanan reported that Spain through Calderon had disavowed to the American government any part in the proposed expedition — thus indicating her abandonment of intention to encourage similar expeditions and removing a main source for apprehension of serious dangers. Later, in May 1848, he assured Ecuador (through instructions in opening regular diplomatic relations) that the American government on every occasion would employ at least all the moral means within its power to discourage and arrest intervention or dictation of European governments in the affairs of independent states of this American hemisphere.

The matured Latin American policy of the Polk administration was expressed by Secretary Buchanan on 1 June 1848 in opening diplomatic relations with Bolivia, the only independent Latin-American country to which the United States had not previously sent a Minister. Urging the necessity of the establishment and maintenance of an American system of policy for protection and security, and emphasizing the fact that «Liberty cannot be preserved without order,» he especially hoped that Peru in order to prevent future irritation and dissension would agree to cede the port of Arica to Bolivia. Possibly encouraged by President Taylor's expression of the American general policy in 1849, Venezuela in 1851 proposed that the United States should form an alliance «or at least take a more decided stand to protect the South American republics.»

In the decade after 1850, the period of American clipper-ship activity in the Pacific, the American government actively used diplomacy to secure protection and expansion of commerce with Latin America — at the same time continuing a policy of securing respect for American commerce by enforcement of American claims for injuries to persons and property. Among the most important subjects of diplomatic negotiation besides claims were the conditions of the guano trade on the west coast, the danger of European influence, the opening of South American rivers to foreign commerce and the conditions of transit at Panama.

In 1852, in connection with difficulties resulting from restrictions on the guano trade, the American government, through Secretary Webster, took steps to protect American interests on the detached Lobos Islands which had been visited by American seamen for half a century, but after an investigation of claims of title soon decided through Secretary Everett to yield to the protests of Peru. In 1858, during the Vivanco insurrection in Peru, a diplomatic dispute arose over the rights of American vessels to obtain guano at the Chinca Islands in connection with the Peruvian seizure of two guano vessels, and resulted in the suspension of diplomatic relations in 1860.

The American acquisition of the Gallipagos Islands from Ecuador, suggested about 1852, was apprehended by Spain, France and Great Britain late in 1854 in connection with an American draft treaty with Ecuador, which was regarded as establishing an American protectorate over the islands which had long been important in connection with American commercial interests in the Pacific. At that time Ecuador, still apprehensive of the plans of General Flores, urged the necessity of eternal vigilance to prevent vast schemes for European ascendency in South America, and apparently New Granada desired the American government to adopt a more liberal policy of sustaining and protecting the nations of South America. The American Minister (Clay) at Lima, convinced that the United States would be forced by circumstances to interfere in the affairs of other states, urged his government to adopt a more effective foreign policy in relations with Spanish America and the establishment of a controlling influence in the western hemisphere. By 1856 there was a decided decline in South American friendliness toward the United States — a decline which resulted largely from the filibustering schemes of William Walker in Central America and which found expression in the «Continental Treaty» signed at Santiago de Chile by representatives of Chile, Peru and Ecuador and designed to form a closer relationship of all Latin American republics. In 1857 the American Minister (Dana) in Bolivia, desiring to create a better Latin American feeling toward the United States, suggested to his government that the basis of the American fixed policy should be the Monroe Doctrine, nonexpansion southward of the Gulf and treaties of alliance guaranteeing the integrity of Spanish America.

In the opening of South American rivers the American government took an active part through diplomacy. In October 1852, after the defeat of the Argentine dictator (General Rosas) by the governor of Entre Rios, it obtained the navigation of the Parana and the Uruguay, which were opened to the merchant vessels of all nations by General Urquiza (provisional director of the Argentine confederation), a privilege later confirmed by treaties with the United States, Great Britain and France in July 1853. At the same time it began preparatory negotiations to secure for American vessels the navigation of the Paraguay River and upper Parana which, after various difficulties resulting in an American naval demonstration, Paraguay was finally induced to grant in 1859 by treaty. Its efforts to obtain the consent of Brazil to the opening of the Amazon, first contemplated even before 1850, begun in 1851 by instructions to naval officers to explore the river from Peru eastward and report its facilities for navigation and its opportunities for commerce, and involving a series of negotiations with Peru and Bolivia and with other countries on the upper waters of the river, reached partial success in 1858 by a treaty with Bolivia guaranteeing the United States access to Bolivian ports on the upper Amazon, and finally attained full success in the Brazilian decree of 1866 declaring the Amazon and its tributaries open to the commerce of all nations. Relations with New Granada concerning the Panama transit route across which an American railroad had been completed in 1855 were especially irritated in 1856 by a riot at Panama, resulting in a series of claims which were not finally settled until 1866. Following the riot Secretary Marcy, desiring to facilitate and protect the transportation of persons and property across the Isthmus, proposed to New Granada a new treaty for lease and cession of a belt of land 20 miles wide from Atlantic to Pacific, and certain islands in the Bay of Panama for use as naval stations, but New Granada declined to negotiate such a treaty.

During the period of civil war resulting from slavery and secession, the American government had little time to cultivate intimate political, social or commercial intercourse with South American countries. On questions in regard to foreign intervention, it maintained the letter of the Monroe Doctrine, but carefully declined South American invitations or suggestions seeking American adhesion to an alliance to guarantee the sovereignty of South American states. A difficult question arose in 1862 in regard to protection of the Panama transit route. The American government through Secretary Seward recognized American duty at Panama but carefully avoided interference in the internal quarrels of Colombia. The adjustment of claims through conventional arrangements for claims commissions or arbitration, begun before 1860 and continued even during the Civil War period, became especially prominent thereafter and removed many sources of irritation and possible collision. The more important in a period of four decades were negotiations with New Granada (or Colombia) in 1857, 1864 and 1874–75; with Chile in 1858, 1873 and 1892; with Paraguay in 1859 and 1887; with Venezuela in 1859, 1866, 1888 and 1892; with Ecuador in 1862, 1865 and 1893 (Santos case); with Peru in 1863 and 1868; and with Brazil in 1870.

Since 1865 the American government has frequently indicated its friendly desire for the welfare and peaceful relations of South American neighbors. When Spain, in a war begun against Peru in 1864, threatened to seize the Chinca Islands, the American government promptly expressed its opposition in a protest to the proposed annexation, although it carefully avoided any actual participation in the war into which it could easily have been drawn by the expectations of Chile and Peru, and stated that American policy did not shield American states from a discharge of their just obligations.

In 1866, when Spain threatened to take permanent possession of the islands as a means of reimbursing the expense of the war through the sale of guano, Secretary Seward secured her withdrawal by a warning that in case of such occupation the United States could not be expected to remain neutral. American mediation resulted in conferences between representatives of the United States, Spain and the allied republics at Washington, and finally in an armistice (in 1871) which, after considerable delay, eventuated in a treaty of peace. A later controversy between Peru and Chile concerning expenditures in maintaining the allied naval squadron in this war was arbitrated in 1875 by the American Minister to Chile by consent of the American government.

Meantime, in October 1866, the American government, although in the interests of peace willing to exercise its good offices to aid in stopping the unhappy war of La Plata (directed against Paraguay by Brazil, Argentina and the Oriental Republic), declined to adopt suggestions for a demonstrative action following the Brazilian rejection of the American good offices. In 1871, acting promptly on a report that Germany had proposed to several European powers the adoption of joint measures to induce Venezuela to observe her agreements, it declared that the United States would observe with great concern the presentation and enforcement of demands against an American state by such a combination.

In 1881 Secretary of State Blaine planned for the United States to assume the position of sole mediator in international disputes to which Latin American republics were parties, but his policy was not continued by his successor. In 1881 the American Ministers at Buenos Aires and Santiago de Chile successfully arbitrated a boundary controversy between Argentina and Chile. In the same year two special American envoys, sent by Secretary Blaine to secure peace between Chile and Peru and Bolivia, which were at war for possession of the nitrate mines near the junction of their boundaries, were unfortunately unsuccessful in their efforts and each was regarded as the partisan of the country to which he was sent. Later the experienced Wm. H. Trescot was sent to warn Chile against excessive demands which might induce the United States to secure co-operation of other American powers to coerce her into reasonable moderation.

Acting on this principle of pan-Americanism, Blaine in 1881 sent invitations to all independent American nations to meet for a discussion of arbitration, but these were recalled by his successor who postponed the conference. The American government promptly recognized the new republic of the United States of Brazil, which was proclaimed following a revolution in the fall of 1889 which resulted in the expulsion of the enlightened Emperor Dom Pedro II and his family on 14 Nov. 1889. In 1893–94 it declined to respect a blockade proclaimed (but later abandoned) by Brazilian naval insurgents against the Brazilian government in the Bay of Rio Janeiro. After having refused to recognize as belligerents the insurgents who claimed to have set up a provisional government at Desterro on the island of Santa Catharina, in January 1894, Admiral Benham, in command of American naval forces and acting in accord with the decision with naval commanders of German, English, French, Portuguese and Italian naval forces, gave notice and practical evidence of his intention, while not intervening to restrict the operations of either party, to protect all American ships entering the Rio waters, thus inducing the insurgents to abstain from further interference with commerce, and perhaps contributing to the later unconditional surrender of the insurgents (on 13 March 1894). In 1889 the President of the United States was chosen arbitrator in the settlement of the Argentine-Brazilian dispute in regard to Misiones territory and finally, in 1895, made an award in favor of the Brazilian claim — a conscientious decision which was gratefully accepted by both governments.

With the increase in the importance of American foreign trade of the 19th century, the American government took steps toward drawing the American states into closer relations in conformity with the idea of a community of interest emphasized so long before by the undefined political bond of union established by the Monroe Doctrine. A comprehensive Pan-American international conference for closer co-operation, such as had been contemplated at Panama in 1824–26 and in later proposals, already partially realized by conferences at Lima in 1847–48, in 1864 and in 1877–78, and at Montevideo in 1888–89, planned by Blaine in 1881, was finally realized at Washington in 1889, resulting in a better understanding and in later conferences which further emphasized the idea of a community of American interests. It established at Washington the International Bureau of American Republics (renamed the Pan-American Union by the Fourth Pan-American conference in 1910) which rendered valuable service by its practical activities. The second Pan-American congress which met in Mexico on 22 Oct. 1901, largely through the quiet suggestion of President McKinley, who tactfully planned to counteract the unfortunate distrust of the United States among Latin Americans, was attended by representatives of all the American republics. Its chief topics of discussion were arbitration and collection of pecuniary claims of citizens of one country against the government of another county. It approved a project for a treaty under which pecuniary claims should be submitted to the international tribunal of arbitration which had been provided at The Hague. It extended the activities of the International Bureau of American Republics, which was also invested with authority to arrange for subsequent congresses. A third Pan-American congress, which met at Rio Janiero, 21 July 1906, was attended by delegates from all American republics except Haiti and Venezuela. It recommended that the next Hague congress should seek to secure a general arbitration treaty and take steps toward the abolition of the use of force in the collection of international debts. The fourth Pan-American congress, which met at Buenos Aires in July–August 1910, discussed compulsory arbitration of pecuniary claims, sanitation, extension of steamer service, patents, trademarks, copyrights and interchange of university professors.

In 1891 a serious difficulty arose between the American government and Chile, with which relations had become somewhat less friendly after 1880 as a result of Secretary Blaine's apparent sympathy with Peru in the War of the Pacific. The decidedly unfriendly feeling created by the American Minister (Patrick Eagan) among the Chilean leaders of the victorious party in the Chilean revolution of 1891, and increased by the American strict interpretation of neutral duties in the seizure of the *Itata,* later culminated in an assault upon sailors of the American cruiser *Baltimore* while ashore at Valparaiso in October 1891, resulting in the suspension of diplomatic relations and an American ultimatum (from Secretary Blaine) to which Chile grudgingly yielded by an apology and the payment of $50,000 damages for the families of persons killed and for the wounded.

In 1895 the American government in applying the principles of the Monroe Doctrine against Great Britain in the Venezuela-Guiana boundary dispute showed a friendly disposition toward Venezuela which was appreciated elsewhere in South America, in spite of Secretary Olney's extreme interpretation, including the provoking assertion that the American fiat was law on the American continent. Later friendly American acts appeared in striking contrast to the bad conduct of the Venezuelan government. Although the American government did not accept the Venezuelan appeal to intervene in 1902 against the debt-collecting activities of Germany and Great Britain (in which it had been invited to participate but which it did not approve), President Roosevelt firmly resisted the later plans of Germany and was successful in terminating the blockade of Venezuela by securing arbitration of the controversy at The Hague under a protocol signed at Washington on 13 Feb. 1903. This friendly action, together with the example of American policy in Cuba contributed much to remove Latin American suspicions arising from the Spanish-American War, American negotiations preliminary to the construction of the Panama Canal and various extensions of the Monroe Doctrine which aroused apprehensions. Unfortunately American relations with Venezuela became strained in 1907, under the presidency of Cipriano Castro, by a serious controversy arising from certain American asphalt concessions and by the arbitrary expulsion of an American editor of a Venezuelan newspaper. The American government, seeking adjustment of all asphalt claims, proposed arbitration, which was refused by Castro. It then agreed to a plan of arbitration by separating the claims, as Castro proposed, but to which he later objected (in March 1908), absolutely refusing to arbitrate any of the cases. In June 1908 the American government withdrew its Minister and suspended diplomatic relations, and two months later offered no objection to the contemplated forcible action of the Netherlands against Castro in return for his conduct against the Dutch islands near the Venezuelan coast. But, when Castro took flight from his troubles, leaving executive affairs in charge of a more reasonable official, J. V. Gomez, who sought a restoration of friendly relations, the American government sent to Venezuela a special commissioner, William I. Buchanan, who on 13 Feb. 1909 signed a protocol under which all disputes were satisfactorily settled — two immediately, two within five months and a last remaining one by later adjudication of The Hague.

American relations with Colombia, which before 1860 were largely concerned with problems of a transit route across Panama, since the American Civil War, were largely influenced by revived American interest in the question of the Panama Canal. In 1868, in accord with the wish of Colombia for certain changes in the treaty of 1846, the American government authorized special negotiations at Bogotá, which resulted in a draft treaty embodying the Monroe Doctrine and securing to the United States absolute control of any canal across the isthmus. This new treaty, although approved by Secretary Seward, was rejected by the Senate of Colombia and changed by amendments and alterations which (in February 1869) failed to receive the approval of the American Senate. The attitude of Colombia turned American attention toward the less desirable Nicaragua route and later resulted in an unfortunate period of American-Colombian estrangement and the «economic» abolition of the American legation at Bogotá for several years before 1878, during which (in 1876) Colombia turned to the French for leadership in the canal enterprise. American interest in the problem was revived in 1879 by De Lesseps' suggestion of a joint international guarantee of neutrality for the canal, resulting (in 1880) in an executive declaration of American policy requiring American control of the canal. In 1881 Secretary Blaine initiated diplomatic measures to defeat the French enterprise by premature denouncement of plans for a European guarantee over the canal, efforts to establish closer relations with Latin America and fruitless negotiations with Great Britain for abrogation of the Clayton-Bulwer Treaty of 1850.

At the close of the Spanish-American War American interest in a canal at Panama was renewed and increased. In 1901 the first substantial step toward the realization of a canal under American control was taken in the negotiation of the Hay-Pauncefote Treaty, which terminated the Clayton-Bulwer Treaty. In 1902 the second step was taken by an act authorizing the purchase of the Panama franchise and unfinished work of the bankrupt French company. The third step — the completion of satisfactory arrangements with Colombia — proved more difficult and unfortunately resulted in strained relations with Colombia from 1903 to 1919. Colombia partly through German influence failed to ratify a convention of 22 Jan. 1903 by which the United States for $10,000,000 and an annuity of $250,000 (beginning 1913), obtained the right to construct the canal and to use and control the canal zone. Panama promptly declared independence from Colombia and was as promptly recognized by the United States which, on 18 Nov. 1903, negotiated with the new republic a treaty similar to that rejected by Colombia, recognizing American control over a canal zone 10 miles wide.

President Roosevelt, whose policy in Panama was generally approved, recognized that Colombia, in spite of her bad faith and her show of resentment against the United States, had a right in equity to compensation. In 1909 Secretary Root negotiated with the Colombian Minister the Root-Cortez Treaty, which provided for recognizing the independence of Panama by Colombia and payment of $25,000,000 (in 10 annual installments) to Colombia by Panama. Colombia, refusing to ratify this treaty, proposed to refer the controversy to The Hague tribunal. The American government, declining this proposal, later made an amicable offer to pay an indemnity of $10,000,000, which Colombia refused to accept. Finally, through instructions of Secretary Bryan, the American government authorized the negotiation of a treaty, signed at Bogotá on 7 April 1914, which expressed the regret of the United States for incidents disturbing the friendship of the two countries, favored Colombia by provisions for readjustment of the Panama boundary and for certain commercial advantages and obligated the United States to pay to Colombia an indemnity of $25,000,000. This treaty, ratified by the Colombian Senate, met strong opposition in the American Senate, which indefinitely postponed action, especially objecting to any expression which might imply a confession of improper policy in relation to the Panama revolution. Later, in July 1919, the Senate resumed consideration of the treaty without the objectionable clause. Meantime, a marked increase of friendly interest between the United States and South American countries followed an extensive tour of Secretary Elihu Root through those countries in 1906 and later visits of other American statesmen and other influential Americans who contributed much to the elimination of misunderstandings and prejudices and the consequent modification of opinions. In 1910 the American government used its good offices in joint action with Brazil and Argentina to settle a boundary dispute between Peru and Ecuador in a mediation which resulted in the submission of the controversy to The Hague. In 1912 its demand of 1909 upon Chile for settlement of the long-existing so-called Alsop claim of $1,000,000 (arising in 1879 from the Chilean seizure of Bolivian territory upon which a Chilean firm with American members had a lien) was arbitrated by King George V whose award allowed about one-third of the original claim and apparently satisfied both Chilean and American governments. In 1909 it secured by mediation the settlement of a boundary dispute between Panama and Costa Rica. Its influence also restored amicable relations between Argentina and Bolivia. In 1914 it negotiated with Panama a new treaty by which it secured certain advantages, including control of the waters of Colón and Ancon, and surrendered the Savannah which gave Panama city direct communication with other territory of the republic.

In April 1914 in the serious Mexican situation which had resulted in severance of diplomatic relations with the United States, the ambassadors of Argentina, Brazil and Chile tendered their mediation, and later together with the ministers of Bolivia, Guatemala and Uruguay were called into consultation by the American government to aid in finding a solution to an embarrassing and dangerous difficulty.

Relations steadily improved during the period of the World War in which American example inspired increasing confidence throughout Latin America. In 1919 renewed efforts were taken to restore satisfactory relations with Colombia.

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SOUTH VICTORIA LAND. See VICTORIA LAND.

SOOY SMITH, William. See SMITH, WILLIAM SOOY.

SOUTH-AMERICAN LITERATURE. See LATIN-AMERICAN LITERATURE.

SOUTH AUSTRALIA. See AUSTRALIA, SOUTH.

SOUTH BEND, Ind., city, county-seat of Saint Joseph County, on Saint Joseph's River near the source of the Kankakee River, and on the Lake Shore and Michigan Southern, the New Jersey, Indiana and Illinois, the Michigan Central, the Saint Joseph, South Bend and Southern, the Terre Haute and Indiana, the Pennsylvania and the Grand Trunk Western railroads, about 89 miles east of Chicago, 135 miles north of Indianapolis, and six miles south of the Michigan State boundary. It is connected by electric lines with Mishawaka, Elkhart, Goshen, La Porte, Michigan City, Valparaiso and New Carlisle, and Niles, Mich., all of which cities and towns contribute to the prosperity of South Bend. The census of 1910 gives the combined population of these places as 86,000. It was settled in 1824 by Alexis Coquillard. It is in the region traversed early by the missionaries and explorers. Across the northern portion of the city was the old portage from the Saint Joseph to the Kankakee. La Salle visited here in 1679 and later years as he journeyed from the «lakes» to the interior. He founded here an Indian village, the Miami tribe; but later the Pottawattomis occupied the place. It is in a fertile agricultural region in which stock-raising is given considerable attention.

Industries.— The city is the industrial centre for a large portion of Northern Indiana. Some of the manufactures are plows, wagons, automobiles and automobile bodies, clover hullers, woolen goods, paper, toys, shirts, sewing machine parts, blank-books, bicycles, baking powder, bluing, bank, bar and office furniture, beer, steam boilers, electrical appliances, street sprinklers, wood and paper boxes, brick, cement, brooms, confectionery, cigars, barrels, cultivators, cutlery, dowels, furniture, feed mills, flour, harness, harrows, machinery, ice, knit underwear, lumber, tombstones, mattresses, proprietary medicines, linseed oil, varnish, pulleys, rubber stamps, sash, blinds, doors, screens, seeders, sheet iron products, steel ranges, malleable steel castings, spark arresters, mineral waters, steel skeins, fishing tackle, indurated fibre goods, pharmaceutical goods for physicans, cigar boxes, electrotypes, grain drills, roofing, automobiles, watches, etc. Nearly all the South Bend factories work the entire year.

The government census of 1914 gives the number of manufacturing establishments 250, the amount of capital invested $54,148,000, the number of employees in the manufactories, not including members of firms, 14,304, annual wages $9,436,000, cost of material used annually $12,742,000, value of products $31,180,000. The capital invested in the carriage and wagon factories is about $20,000,000, and the value of the annual output $10,000,000. The output of the agricultural implements works is about $3,500,000, and of the foundry and machine-shop products $3,500,000. There are over 40 wholesale houses.

Buildings and Parks.— The principal public buildings are the government building, county courthouse and county jail ($40,000), city hall $75,000, Chamber of Commerce, Y. M. C. A. building, Saint Joseph's Hospital, Saint Anthony's Convent, the city hospital and two theatres. The public parks embrace 280 acres. There are four playgrounds, one 20-acre play-field and 13 social centres. The water supply comes largely from 62 artesian wells; there are about 100 miles of water mains.

Churches and Schools.— There are 44 church buildings and 51 church organizations, representing 18 different denominations. The educational institutions are one public high school, 18 public schools, 12 parish schools, Saint Aloysius and Saint Joseph's academies, conservatory of music, commercial schools, teachers' training school, historical society and a public library. Just outside the limits of the city, in the village of Notre Dame, are the large Roman Catholic schools, the University of Notre Dame (q.v.) for men and Saint Mary's College for women.

Banks and Banking.— The four national banks have a combined capital of $500,000; the County Savings Bank has resources to the amount of $4,500,000, deposits $5,000,000 and a surplus of $250,000. There are six building and loan associations.

Government and Population.—The government is administered under a special charter granted by the legislature which provides for a mayor and a council of 10 members. The members of the council hold office for a term of two years. There are about 20 nationalities represented in the city. The various industries and the good wages attract skilled workmen to South Bend. The principal nationalities, other than the English-speaking races, are Germans, Swedes, Poles, Belgians, Hungarians and Danes. Pop. 65,300.

SOUTH BERWICK, Me., town, York County, on the Salmon Falls River, and on the Boston and Maine Railroad, 40 miles southwest of Portland. Its chief manufacturing interests include shoe factories, cotton and woolen mills and carriage shops. The town has a public library and is the seat of Berwick Academy, a non-sectarian secondary school chartered in 1791. Pop. about 3,000.

SOUTH BETHLEHEM, bĕth'lē-ĕm, Pa., borough Northampton County, on the Lehigh Valley and the Philadelphia and Reading railroads, about 12 miles west of Easton, the county-seat, and about 40 miles, in direct line, north of Philadelphia. Electric railroads connect it with Allentown, Bethlehem and other places in the vicinity.

South Bethlehem was settled in 1741; but for many years it increased slowly in population and its industries were limited to local needs. Since 1850 the number and magnitude of the industries have increased and the borough has grown in proportion. It is in a manufacturing section, where iron ore deposits and coal fields are convenient and where there are good transportation facilities. The chief industrial establishments are iron and steel works, machine shops, foundries, zinc and brass works, wood working factories, knitting mills, silk mills, coke works, ice plant, cigars and furniture works. The government census of 1914 gives the number of manufacturing establishments as 43, the amount of capital invested $68,973,000, the number of employees, not owners 10,892, the total wages $8,279,000, the cost of material used $22,621,000. the value of the product, $40,179,000. It ranks 19 in the State in the value of its manufactured products.

There are 21 churches, Saint Luke's Hospital and one home. The educational institutions are the Lehigh University, which has 15 large buildings, Bishopthorpe School, an institution for girls, a public high school, public and parish elementary schools and public and school libraries. Pop. 23,000.

SOUTH CAROLINA, a South Atlantic State of the United States of America, one of the original 13, and popularly called «The Palmetto State,» lies between lat. 32° 4′ 30″ and 35° 12′ N. and between long. 78° 30′ and 83° 20′ W. Its area is 30,989 square miles, of which 494 square miles is water. The State of North Carolina bounds it on the north; the Savannah River, the eighth river in length in North America, on the southwest and west; the Atlantic Ocean on the south, southeast and east forms the base of an irregularly shaped triangle with its apex resting on the Appalachian Mountains 200 miles to the north.

Topography.—*Coast Region.*— The coast region has an area of 1,700 square miles. The average elevation above sea-level is 10 to 15 feet, rarely 25 to 30. South of the Santee River the mainland is bordered by numerous islands, formed from the detritus brought down by the rivers and banked up south of their outlets by the currents and waves of the sea. They are fringed between high and low tide by salt marshes and extensive beds of oysters peculiar to this latitude. The mean rise of the tide in the Savannah River is 6.9 feet, and diminishes eastward to 3.5 feet at the Georgetown entrance. The tides push the fresh water of the streams before them on the flood, 15 to 30 miles inland, and render tide-water irrigation of the rice fields practicable. The salt water rivers separating the islands from each other and from the mainland furnish navigable waters for a length of 400 to 500 miles for steamboats and might, with little work, be converted into a continuous inside passage from one boundary of the State to the other.

The Lower Pine Belt.— Immediately north of the coast region the Lower Pine Belt, with a width varying from 20 to 70 miles, crosses the State from east to west, covering an area of 10,226 miles. These low-level lands bear a strong resemblance to those of the coast. The uplands, the so-called «pine barrens,» represent the sea islands, the numerous large fresh-water rivers replace the salt rivers and arms of the sea, and the swamps, covering over 2,000 square miles, recall the salt marshes. Eight large rivers conveying all the rainfall of South Carolina, with a considerable portion of that from North Carolina and Georgia, together with several smaller rivers and innumerable lesser streams, traverse the region. The maximum elevation, 134 feet, is reached at Branchville, making the fall to tide water in a direct line 2.8 feet per mile. In the extreme west the fall is greater, 5.8 feet a mile; in the Pee Dee section it is less than a foot to the mile. With proper engineering the fall is sufficient to drain the swamps and bring into cultivation what are perhaps the most fertile lands in the State.

The Upper Pine Belt.— The Upper Pine Belt, or central cotton region, lies north of the Lower Pine Belt and south of the Sand and Red Hill region. It covers 6,230 square miles. The elevation, 130 to 269 feet. There are extensive bodies of very fertile swamps in the rivers, subject, however, to occasional overflows, and back swamps equally fertile but needing drainage.

Sand and Red Hills.— A range of sand hills rises from the gentle slope of the Upper Pine Belt and attains an elevation of 500 to 826 feet. It is interrupted by hills and elevated levels of red clay lands. Its northern boundary is the «fall line» of the rivers. It covers 4,061 square miles. Extensive quarries of kaolin clay are worked here; works for the manufacture of porcelain ware from them have been successfully operated, and many thousand tons are annually shipped to the paper manufactories. Fuller's earth is also found. A «cement gravel» has been much exploited for road material, being shipped by rail to distant points for that use. Roads covered a few inches with it become hard and withstand the weather and much travel. The long slopes of these hills face south, and the short slopes north. The latter are the most fertile. Besides rivers, the large clear swift running creeks, not counting smaller streams and branches, aggregate 1,100 miles in length. Their average fall is 15 to 20 feet to the mile.

Piedmont Region.— The average elevation is 700 feet, rising from 545 at Winnsboro to 989 feet at Greenville. It covers 10,245 square miles. Inexhaustible quantities of building granite of fine quality occur in Fairfield, Newberry, Kershaw and other counties. Mica slate is found in Abbeyville and Anderson. The peculiar soils known as the «flatwoods» of Abbeyville, and the «meadow lands» of Union, and also the «black jack flats» of Chester and York, are due to the weathering of extensive trap dikes in those localities. Lieber wrote in 1859, «above this line (the 'fall line') most streams have some gold in their sands.» Thirty-one gold mines were opened in the talc slates of Chesterfield, Lancaster, Abbeyville and Edgefield counties. The Dorn Mine (now McCormick), in the last-named county, has yielded $1,100,000. There were 19 gold mines in the mica slates of Spartanburg, Union and York counties. Gold production is about at its end, only $3,789 worth being produced in 1915. Eight other, chiefly gravel, deposits, are in Greenville and Pickens counties. Argentiferous galena and copper are found in these mines, bismuth in quantity at Brewer Mine in Chesterfield County; iron in magnetic and specular ores in large quantity at Kings Mountain and elsewhere in Spartanburg and Union counties; limestone in York, Pickens, Spartanburg and Laurens; in the latter county there are quarries of marble; feldspar in Pickens, Abbeyville, Anderson and Laurens; barytes on the Air Line Railroad in York; manganese in abundance and purity at the Dorn

SOUTH CAROLINA.

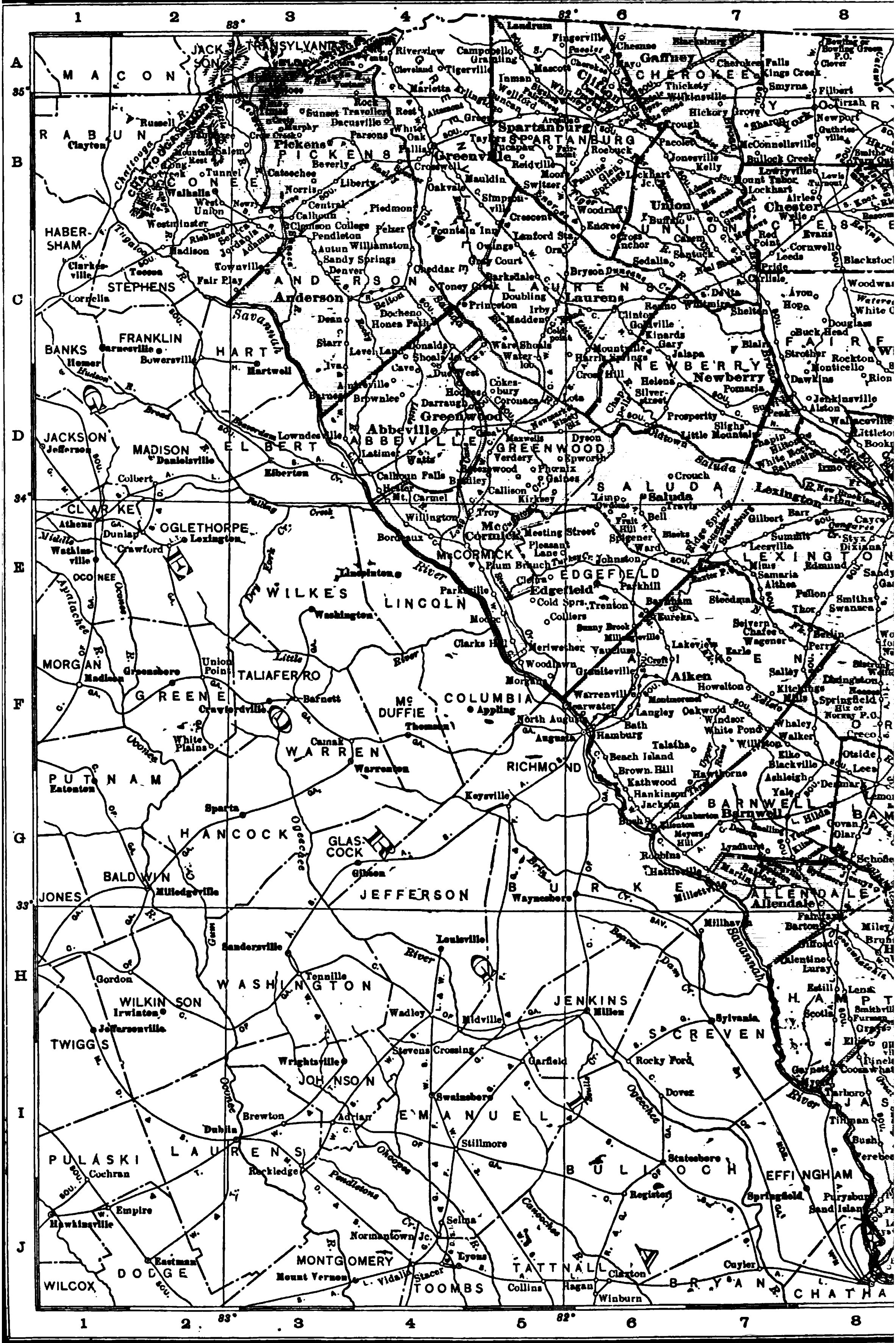
Estimated population 1,625,475

COUNTIES

Pop.		
34,804	Abbeville	D 4
41,849	Aiken	F 6
.....	Allendale (Pop. incl. in Barnwell Co.)	G 7
69,568	Anderson	C 3
18,544	Bamberg	G 8
34,209	Barnwell	G 7
30,355	Beaufort	J 9
23,487	Berkeley	G 12
16,634	Calhoun	E 9
88,594	Charleston	H 12
26,179	Cherokee	A 7
29,425	Chester	B 8
26,301	Chesterfield	C 11
32,188	Clarendon	E 11
35,390	Colleton	H 9
36,027	Darlington	D 12
22,615	Dillon	C 13
17,891	Dorchester	G 10
28,281	Edgefield	E 5
29,442	Fairfield	C 8
35,671	Florence	D 12
22,270	Georgetown	F 14
68,377	Greenville	B 4
34,225	Greenwood	D 5
25,126	Hampton	H 8
26,995	Horry	E 14
....	Jasper (Pop. incl. in Hampton and Beaufort Cos.)	I 8
27,094	Kershaw	C 10
26,650	Lancaster	B 9
41,550	Laurens	C 5
25,318	Lee	D 10
32,040	Lexington	E 8
.....	McCormick (Pop. incl in Abbeville and Edgefield Cos.)	E 4
20,596	Marion	D 13
31,189	Marlboro	C 12
34,586	Newberry	D 7
27,337	Oconee	B 2
55,893	Orangeburg	F 7
25,422	Pickens	B 3
55,143	Richland	D 9
20,943	Saluda	D 6
83,465	Spartanburg	B 5
38,472	Sumter	E 10
29,911	Union	C 7
37,626	Williamsburg	F 12
47,718	York	B 8

Incorporated Cities, Towns, Villages, Etc.

4,459	Abbeville	D 4
3,911	Aiken	F 6
1,453	Allendale	G 7
12,266	Anderson	C 3
156	Appleton	G 7
1,937	Bamberg	G 9
1,324	Barnwell	G 7
1,995	Batesburg	E 7
2,486	Beaufort	I 9
1,652	Belton	C 4
2,646	Bennettsville	C 13
317	Bethune	C 10
196	Bingham	C 13
1,659	Bishopville	D 11
1,119	Blacksburg	A 7
192	Blackstock	C 8
1,278	Blackville	F 7
116	Blaney	D 9
228	Blenheim	C 13
577	Bluffton	J 9
160	Bolen, Orangeburg	F 9
327	Bowman	F 10
50	Bowyer	G 10
279	Bradley	D 5
1,471	Branchville	G 9
610	Brunson	H 8
215	Calhoun	C 3
296	Calhoun Falls	D 4
3,569	Camden	D 10
421	Cameron	F 9
255	Campobello	A 4
367	Carlisle	C 7
886	Central	B 3
345	Chapin	D 7
150	Chappells	D 6
60,734	Charleston	H 11
2,873	Cheraw	C 12
4,754	Chester	B 8
618	Chesterfield	B 11
4,900	Clifton	B 6
3,272	Clinton	C 6
780	Clio	C 13
1,207	Clover	A 8
290	Cokesbury	D 5
34,611	Columbia	E 9
1,228	Conway	E 14
174	Cope	F 9
199	Coronaca	D 5
418	Cottageville	H 9
1,101	Cowpens	B 6
558	Cross Hill	D 6
3,789	Darlington	D 11
1,075	Denmark	G 8
1,757	Dillon	C 13
268	Donalds	C 4
169	Dovesville	C 12
672	Due West	D 4
190	Duncan	B 5
2,983	Easley	B 4
237	Eastover	E 9
1,234	Eau Claire, Richland	D 9
190	Ebenezer, York	B 8
1,771	Edgefield	E 5
113	Edgmoor	B 9
315	Ehrhardt	G 8
114	Elko	F 7
367	Ellenton	G 6
540	Elloree	F 9
460	Estill	H 8
405	Eutawville	G 10
499	Fairfax	H 8
7,057	Florence	D 12
115	Foreston	F 11
134	Fork	D 13
204	Fort Lawn	B 9
1,616	Fort Mill	A 9
392	Fort Motte	E 9
979	Fountain Inn	C 4
4,767	Gaffney	A 6
5,530	Georgetown	G 13
178	Glenn Springs	B 6
111	Govan	G 8
284	Gray Court	C 5
630	Greelyville	F 11
18,181	Greenville	B 4
6,614	Greenwood	D 4
1,673	Greer	B 4
67	Grover	G 10
748	Hampton	H 8
190	Harleyville	G 10
2,365	Hartsville	D 11
452	Heath Springs	C 9
425	Helena	D 6
319	Hendersonville	H 9
285	Hickory Grove	B 7
266	Hodges	D 5
342	Holly Hill	G 10
1,763	Honea Path	C 4
474	Inman	A 5
267	Irmo	D 8
894	Iva	D 3
54	Jacksonboro	H 10
390	Jefferson	B 10
943	Johnston	E 6
969	Jonesville	B 7
92	Kelton, Union	C 7
62	Kemper	D 14
950	Kershaw	C 10
1,372	Kingstree	F 12
199	Kline	G 8
1,074	Lake City	E 12
592	Lamar	D 11
2,098	Lancaster	B 9
449	Landrum	A 5
1,358	Latta	D 13
4,818	Laurens	C 6
980	Leesville	E 7
162	Lewiedale, Lexington	E 8
709	Lexington	E 8
1,058	Liberty	B 3
341	Lincolnville	G 11
440	Little Mountain	D 7
99	Little Rock	C 13
168	Livingston	F 8
263	Lodge	G 9
229	Loris	D 15
350	Lowndesville	D 3
343	Lowryville	B 8
139	Lucknow	D 11
466	Lynchburg	D 11
187	McBee	C 10
1,628	McColl	C 13
279	McConnellsville	B 8
613	McCormick	E 4
96	Mallory	C 13
1,854	Manning	E 11
3,844	Marion	D 14
473	Maryville, Charleston	H 12
751	Mayesville	E 11
96	Midway	G 9
108	Modoc	E 5
232	Moncks Corner	G 11
122	Monetta	E 7
1,011	Moultrieville	H 12
264	Mt. Carmel	D 4
1,346	Mt. Pleasant	H 12
150	Mountville	C 6
1,832	Mullins	D 14
143	Neeses	F 8
900	New Brookland	E 8
5,028	Newberry	D 7
118	Nichols	D 14
758	Ninety Six	D 6
180	Norris	B 3
561	North	F 8
1,136	North Augusta	F 6
315	Norway	F 8
230	Olanta	E 12
350	Olar	G 8
5,906	Orangeburg	F 8
410	Pacolet	B 6
360	Pageland	B 10
157	Pages Mill	C 14
197	Parksville	E 5
98	Patrick	C 11
175	Paxville	E 10
183	Peak	D 7
822	Pendleton	C 3
179	Perry	F 8
897	Pickens	B 3
424	Pinewood	E 10
145	Plum Branch	E 5
363	Port Royal	J 9
182	Princeton	C 5
737	Prosperity	D 7
205	Reevesville	G 10
177	Reidville	B 5
245	Richburg	B 8
330	Ridgeland	I 9
505	Ridge Spring	E 7
300	Ridgeville	G 10
370	Ridgeway	D 9
7,216	Rock Hill	B 9
194	Ruby	B 11
508	Rowesville	F 9
139	Salem	B 3
311	Salley	F 8
610	Saluda	D 6
189	Scotia	H 7
308	Scranton	E 12
458	Sellers	D 13
1,313	Seneca	B 3
795	Shandon, Richland	D 9
374	Sharon	B 7
113	Sieglingville	G 7
521	Simpsonville	B 5
109	Smyrna	A 7
338	Snelling	G 7
21,365	Spartanburg	B 5
438	Springfield	F 8
957	St. George	G 10
1,377	St. Matthews	E 9
408	St. Stephen	F 12
678	Summerton	F 11
2,355	Summerville	G11
87	Summit	E 7
9,639	Sumter	E 11
523	Swansea	E 8
99	Sycamore	G 8
225	Tatum	C 13
1,708	Timmonsville	D 12
128	Tirzah	B 8
255	Townville	C 3
257	Trenton	E 6
198	Trio	F 12
233	Troy	E 5
190	Ulmers	G 7
5,623	Union	B 7
97	Vance	F 10
542	Varnville	H 9
362	Wagener	F 7
1,595	Walhalla	B 2
1,677	Walterboro	H 10
183	Ward	E 6
191	Waterloo	C 5
370	Wellford	B 5
1,576	Westminster	B 2
328	West Union	B 2
107	Westville	C 10
85	White Rock	D 8
1,045	Whitmire	C 7
1,957	Williamston	C 4
365	Willington	E 4
624	Williston	F 7
1,754	Winnsboro	C 9
190	Woodford	F 8
1,880	Woodruff	B 6
1 250	Yemassee	H 9
2,326	Yorkville	B 8
195	Zion	D 13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Madison
GREENE
Greensboro
TALIAFERRO
McDUFFIE
Thomson
COLUMBIA
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Sparta
GLASCOCK
Gibson
BALDWIN
Milledgeville
JONES
JEFFERSON
Louisville
BURKE
Waynesboro
ALLENDALE
Allendale
WASHINGTON
Sandersville
Tennille
WILKINSON
Irwinton
JENKINS
Millen
HAMPTON
TWIGGS
Jeffersonville
SCREVEN
Sylvania
JOHNSON
Wrightsville
EMANUEL
Swainsboro
Stillmore
PULASKI
LAURENS
Dublin
BULLOCH
Statesboro
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Mount Vernon
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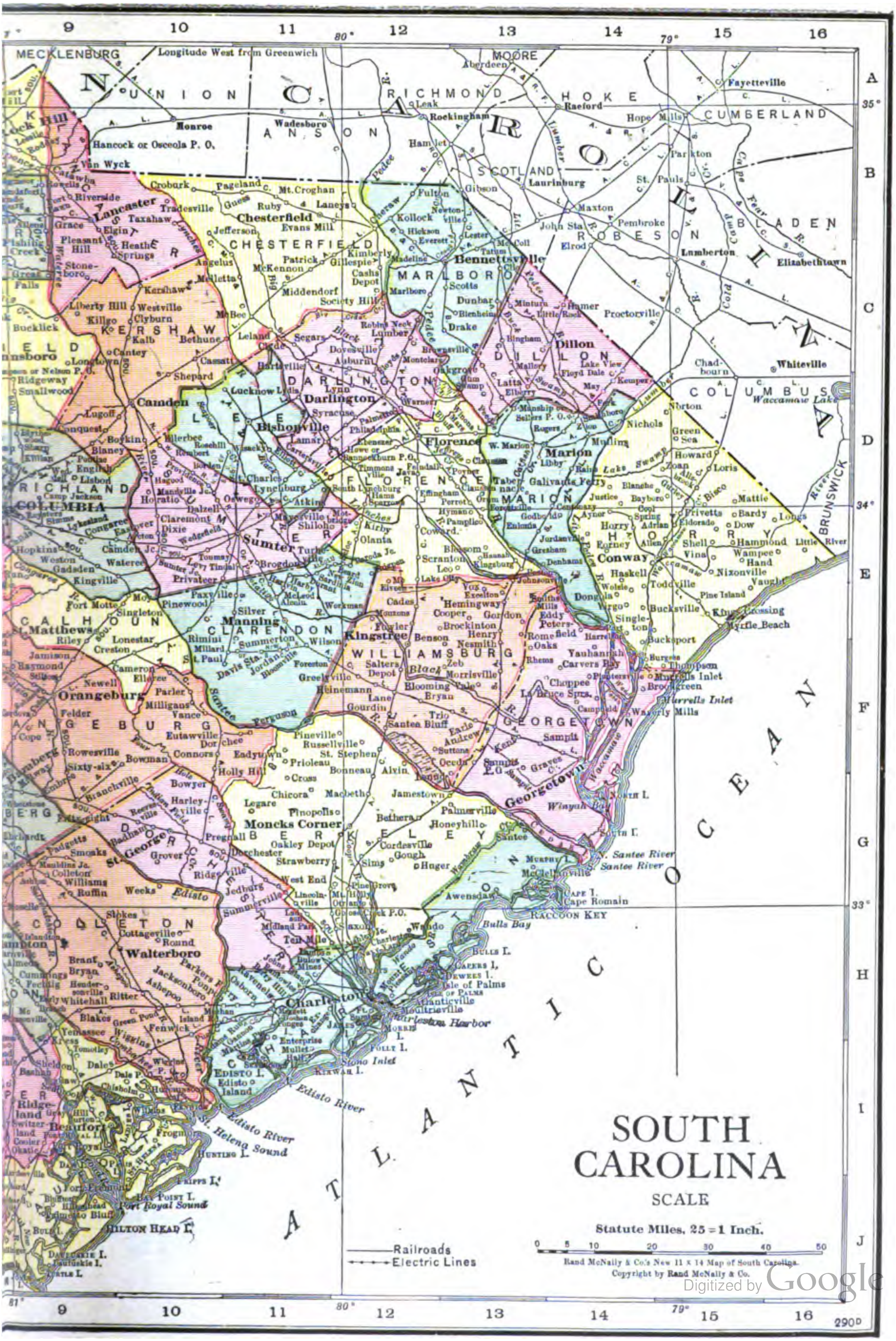

SOUTH CAROLINA

SCALE

Statute Miles, 25 = 1 Inch.

0 5 10 20 30 40 50

Railroads

Electric Lines

Rand McNally & Co.'s New 11 x 14 Map of South Carolina.
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mine, and in Abbeyville, York and Pickens; asbestos in Spartanburg, Laurens, York, Anderson and Pickens; spinel rubies in Pickens; tourmaline in York, Edgefield and Laurens; beryl in Edgefield and Laurens; corundum in Laurens; zircons in Abbeyville and Anderson; one diamond has been taken from the itacolumite in Spartanburg.

Alpine Region.— The Alpine Region occupies the extreme northwestern corner of Carolina. It has an average elevation of 1,000 to 1,500 feet; Kings Mountain is 1,692 feet; Paris Mountain, 2,054 feet; Cæsar's Head, 3,118 feet; and Mount Pinnacle, 3,426 feet. The mountains here often rise suddenly to their greatest height. The southeastern front of Kings Mountain is 500 feet in perpendicular height, Table Rock is 800 feet vertically above its southeastern terrace. The northwestern slopes descend gradually toward the Blue Ridge Mountains. There would seem to have been in ages past some great fault or land slip here, producing the long southeastern incline running down to the sea, and continuing under its waters for 100 miles to the Gulf Stream, where the 100-fathom depth suddenly sinks to 1,500 fathoms. The region covers 1,281 square miles.

Geology.— Sands, clays, soft limestones and marls more or less unconsolidated characterize the coastal region. They range from the Cretaceous to the Tertiary period. In the Lower Pine Belt outcrops of the Cretaceous rocks are noted in the extreme southeastern corner of the State, and have been traced northward to Mars Bluff and Darlington, where it passes under the Buhrstone of the Eocene. Superimposed on these Cretaceous marls are the Santee marls. They belong to the Eocene and are composed of corals and gigantic oyster shells. Just above tide-water they pass under the Ashley and Cooper marls, composed of many-chambered cells (Foraminifera), sometimes of so fine and compact a structure as to fit them for building purposes. Fragments broken from these marls and rounded by wave action form the phosphate rock of commerce. These nodules contain 55 to 61 per cent of phosphate of lime and have been quarried at the depth of one to six feet; they are also found on the bottom of the rivers, and on sea bottoms from North Carolina to Florida. The remains of the mastodon, elephant, tapir, horse, etc., are found mingled with them. Green sands containing 4 to 6 per cent of potash in the form of glauconite also occur here. A sandy loam overlays the Santee (Eocene) marls of the Upper Pine Belt. In the northern portion these marls have been petrified and converted into Buhrstone. In the eastern part of the belt are outcrops of the Cretaceous, and occasional islands of Miocene marls. In the Sand and Red Hills region no lime occurs, the Eocene marls having been converted into Buhrstone. The formations bear evidence of being littoral. Beds of lignite occur in Aiken and Chesterfield; kaolin and other commercial clays abound in this region. Above the «fall line» the rocks of the Piedmont country occur in the following order of superposition. On granite rests the gneiss, above them occur islands of greater or less extent of mica talc and clay slates, itacolumite and limestones, left from the denudation to which the region has been subjected for ages. The rocks and minerals of the Alpine region correspond with those of the Piedmont.

Hydrography.— Three considerable river systems take their rise in these mountains, and make their way southwardly to the sea. The eastern watershed of the Savannah is narrow, as is also the western watershed of the Pee Dee. The intermediate space occupying the larger portion of upper Carolina is crossed by seven rivers, the Saluda, Tyger, Reedy, Pacolet, Broad, Catawba, Wateree, with their numerous affluents uniting to form the Santee River. A line across the State from Augusta, Ga., to Columbia and thence to Cheraw in the east, is known as the «fall line.» On crossing this line the streams pass from the crystalline rocks, the granites and slates of upper Carolina, into the softer strata of the tertiary marls of the low country. Above the «fall line» the average slope of the streams is five feet to the mile, and they are available for the development of water powers to an extent estimated at 1,000,000 horse power. Below the fall eight other rivers, the North and the South Edisto, the Combahee, the Coosawhatchie, Black River, Cooper, Ashley, Waccamaw, are found with a fall of one to one and one-half feet to the mile. The numerous creeks, however, that feed these rivers, rising themselves in the elevation of the Sand Hills and Red Hills, have a much more rapid fall. Horse Creek, for instance, emptying into the Savannah below Augusta, furnishes in the length of 10 miles power for the Vaucluse, Graniteville, Langley, Aiken and Clearwater factories, without being fully utilized. The rivers are navigable to the «fall line» for steamboats not exceeding 200 tons burden, and in all there is from 700 to 800 miles of navigation above tidewater.

Flora.— The palmetto and the live oak characterize the growth of the coast region, which also produces oranges of superior quality and figs in great abundance. Magnolias also abound from the coast to some distance inland. The swamps are characterized by cypresses, gums and bay trees. The long-leaf pine, water oaks and hickories are common on the uplands near the coast. Hard woods are predominant on the Piedmont plateau; deciduous oaks are most common, but birch, beech, ash, black walnut, maple, sycamore, chestnut and tulips are also plentiful. The mountains have cucumber trees, hemlock, white pine and laurel. Among indigenous species of economic importance are the grape, blackberry, pawpaw, plum, persimmon, crabapple, hazel nut, walnut, pecan, apricot, cherry and pear. Ginseng, bloodroot, horehound, redroot, horsemint, wild flax are the commonest medicinal plants, while the flowering varieties are represented by the lilies, roses, violet, golden rod, woodbine, azaleas and jessamines.

Fauna.— Deer, rabbits, squirrels, muskrats, raccoons, opossums, minks, ducks, wild turkeys, quail, snipe and woodcock are the best represented of the animals and birds. Foxes, bears, wolves, wildcats are now rare, while within memory panthers have become extinct. There are several varieties of songbirds, including all ordinary varieties. In the bays and rivers are porpoises, whiting, bluefish, seabass, shad, sturgeon, mullet, snappers, sheepshead, weakfish, oysters, shrimps and terrapins. In the upper courses of the rivers are catfish, pike, perch and trout.

Climate.— The mean annual temperature in the coast region is 63° to 65° F.; summer mean, 74° to 79°; winter 54° to 56°; rainfall, 50 to 80 inches. In the Sand and Red Hills region the climate is dry, but it enjoys an abundant rainfall and is well watered. The Alpine region has a distinctly salubrious climate. The highest mean temperature (for a week) ever recorded there was 90° F.; the lowest was 25° F. The mean annual temperature there is from 55° to 58° F. The rainfall is heavy, dewless nights are rare and vegetation is in consequence luxurious. The mean annual temperature for the whole State is about 62° F.; the mean summer temperature, 79° F., and the mean winter temperature 44° F. The mean annual rainfall is 49 inches; it is well distributed and about 17 inches falls during the summer or growing season. Snow is uncommon in the southern part of the State and usually melts as it falls, but in the north snowfalls of several inches are not uncommon. Tornadoes sometimes sweep over the western part, while at intervals hurricanes from the West Indies ravage the eastern part of the State.

Soils.— In the Piedmont plateau the soil is a mixture of sand and clay, the result of the disintegration of the rocks of the region. On the hillsides of the river basins is the type of soil which is most common in the State, the deep red clay. The upper part of the coastal plain has a poor, sandy soil of little fertility, but the lower part has a finer sand which is much more fertile. Along the rivers and about the Sea Islands are the swamp muck and clay soils of great fertility.

Mineral Industry.— The minerals worked are phosphate rock, which is found in a belt of about 70 miles from the mouth of the Broad River to the headwaters of the Wando, in Berkeley, Dorchester, Charleston, Colleton and Beaufort counties. In 1915, 83,460 long tons (2,240 pounds), valued at $310,850, were mined. The production is declining in South Carolina. Granite in 1915 was produced to the value of $321,612 and clay products (brick and «paper clays») to the value of $379,133. Gold production, once important, has now practically ceased. In 1915 only 183 fine ounces ($3,789) were produced. The State produces also silver, manganese, iron, lime and monazite in small quantities. The value of the total mineral output (including coal products, sand, etc.) was $1,129,709 in 1915 and $1,414,249 in 1914.

Agriculture.— The settlers in Carolina soon ascertained that its soil and climate were suitable for all the plants of the Old World growing from the subtropical to the subarctic regions, besides a most varied flora of its own. They found also extensive pastures supporting numerous herds of wild buffalo, elk and deer. The horses and cattle introduced by the Spaniards increased rapidly in numbers. It might have been thought that here were elements favorable for a diversified husbandry. The colonists, however, discovered an agricultural monopoly and an export «money crop» in rice. It required capital for drainage and irrigation and a thoroughly organized and reliable labor able to resist the malarial influences of the rice swamps. Negro slaves fulfilled these conditions. English merchants furnished the negroes and supplies on credit. The English Parliament favored the exportation of rice and it became a most profitable crop. When cotton was introduced in the 18th century, as it grew on healthy uplands, and did not require much capital, it was suspected that the small white farmer would undertake its culture. The small farmers, however, did not, except as overseers, take to cotton planting until after the emancipation of the slaves. The small farmers of both races modeled themselves after the methods of an agriculture that had been successful for nearly two centuries. They confined their energies largely to one «money crop» for export. They worked at it with hired labor, on borrowed money, purchased instead of breeding work animals, bought a notable portion of their supplies and largely of fertilizers.

The Lien Law securing the collection of advances made on growing crops, often even before they were planted, and the Lien Law requiring the enclosure of all livestock, leaving lands under crops unenclosed, promoted existing tendencies in agriculture. Removing the cost of fencing on lands under crops led to a wide deforestation and careless cultivation.

In 1880 there were 93,864 farms in the State containing 13,457,613 acres, of which only 4,132 acres were improved. In 1890 the number of farms had increased to 115,008, with 13,985,014 acres, of which 5,755,741 acres were improved. There are now (1919) 176,434 farms in the State, covering an area of 13,512,028 acres, of which 6,097,999 acres are improved. Farm property, machinery and livestock had a total value of $84,079,702 in 1880. This value is now well over $400,000,000. About 68 per cent of the area of the State is woodland. The chief cereal crops in 1918 with their acreage and production were: wheat, 205,000 acres, 2,225,000 bushels, valued at $5,863,000; maize, 2,250,000 acres, 38,250,000 bushels, valued at $74,588,000; oats, 500,000 acres, 11,000,000 bushels, valued at $12,980,000; rice, 4,500 acres, 104,000 bushels, value $203,000. Of greater importance in the agricultural life of the State is the cotton crop, to which 3,047,000 acres were planted in 1918, producing 1,500,000 bales of upland variety, valued at $20,700,000. Tobacco in the same year was planted in 86,400 acres and yielded 62,208,000 pounds, valued at $18,662,000. The hay crop of 1918 was taken from 260,000 acres, yielded 286,000 tons, valued at $7,465,000. Peanuts were planted on 14,000 acres, yielded 630,000 bushels, valued at $1,840,000. About 80,000 acres were planted to sweet potatoes, of which 7,600,000 bushels were produced, valued at $10,792,000. Potatoes were planted on 28,000 acres, yielded 2,856,000 bushels, valued at $5,512,000. The farm animals in the State 1 Jan. 1919 were 82,000 horses, 194,000 mules, 203,000 milch cows, 244,000 other cattle, 29,000 sheep and 1,056,000 swine. The value of these livestock was $76,577,000.

More than 50 per cent of the farms are negro farms; about 25 per cent of the negro farmers are owners, 50 per cent cash tenants and 25 per cent share tenants. A higher percentage of white farmers are owners. Poultry products amounted to about $2,000,000 in 1918. Honey and beeswax were produced in the same year to the value of $80,000.

Fisheries.— The State has active fisheries, mainly oysters, whiting, shad and sea-bass. The industry gives employment to about 3,000 persons and has an invested capital of $125,000. The annual catch rarely exceeds $300,000 in value.

Forest Products.— Yellow pine, also called Southern pine, is the chief lumber resource of the State. The stand of this wood alone is estimated at 3,000 million feet. It is being depleted at a rapid rate. There are about 450 mills which cut about 750,000 M. F. B. per year. The value of all forest products in 1918 was over $5,000,000. Cypress, oak, locust and other pines are also being exploited.

Manufactures.— Antedating the establishment of the Patent Office by more than a century, the colonial assembly in 1691 passed an act "for rewarding ingenious and industrious persons to essay such machines as may conduce to the better propagation of the produce of this State." In 1778 tide water power was for the first time utilized in milling for cleaning rice. The machinery of these mills is the model on which this industry (performed before by hand) has since been conducted. A cotton factory was established in 1784 at Murray's Ferry, Williamsburg, and one at Statesburg a few years later. The first saw gin — patented by Ogden Holmes and serving as the type of all the short staple cotton gins of the South ever since — was erected in 1795 on Mill Creek, Fairfield County. Mills in the statistics of South Carolina, 1826, states that Mr. Waring operated a small cottonseed-oil mill at Columbia and "expressed from cotton seed a very good oil." In addition to this the improved gins operated at these mills have greatly cheapened the cost of ginning, which, together with high prices paid for seed, adds a few cents per pound to the value of lint cotton. The oil is a good edible oil and the by-products, meal and hulls are the cheapest form of stock food and fertilizer.

The manufactured products of South Carolina, as reported by the recent industrial census, were valued at $138,891,202; its factories gave employment to 71,914 wage-earners, who received $24,173,101 for their services. The capital invested in industry amounted to $203,210,875, the cost of materials was $91,008,196, leaving the value added by manufacture $47,882,208. The State ranked 31st in the value of products and 25th in the number of wage-earners employed in manufactures.

The manufacture of cotton goods is the most important manufacturing industry. It gives employment to 64.6 per cent of all wage-earners and its products form 56.5 per cent of the total for all industries. There are only two States — Massachusetts and North Carolina — that exceed this State in the value of cotton manufactures. There are in operation 4,327,178 spindles, or 13.7 per cent of the total in the United States. The industry is fostered by the great cotton crop of the State. Oil, cottonseed and cake extracting is the second industry and is of course a by-product of the cotton growing and cotton spinning and ginning industries. Fertilizer manufacture is also important.

Of the wage-earners 82.5 per cent are 16 years of age and over, and of this number 19.6 per cent were females. The turpentine and resin industries are declining owing to the exhaustion of suitable timber.

The relative importance of the leading manufacturing industries is shown in the following table:

INDUSTRY	Number of establishments	Average number of wage-earners	Value of products
Cotton goods	148	46,448	$78,446,145
Oil, cottonseed and cake	97	2,037	16,379,858
Fertilizers	55	2,050	13,824,659
Lumber and timber products	793	11,308	11,657,800
Cars and shop construction	9	1,431	2,064,141
Printing and publishing	166	893	1,985,263
Mineral and soda waters	113	391	1,541,284
Foundry and machine shop products	40	515	937,472
Artificial ice	36	368	818,223
Bread and bakery products	66	286	805,602
Hosiery and knit goods	6	771	749,394
Brick, tile, pottery and clays	36	706	589,852
Carriages, wagons, etc	18	209	499,591
Gas, illuminating and heating	12	136	496,225
Flour and grist mills	37	30	420,629
Marble and stone	37	283	400,938
Canning and preserving	16	464	345,064
Confectionery	22	85	226,204
Men's clothing	4	116	214,559
Food preparations	5	16	202,248
Paving materials	5	245	188,946
Turpentine and resin	35	221	151,801
Copper, tin and sheet-iron work	9	71	121,667
All others	120	2,834	5,823,637
Total	1,885	71,914	$138,891,202

Communications.— The Savannah River is an important trade and travel route. Improvements have rendered it navigable for over 200 miles, from Savannah to Augusta, Ga. The Waccaman is navigable for 50 miles; the Great Pee Dee for 52 miles; the Cooper for 30 miles and the Edisto for 260 miles, while several other streams are navigable for distances up to 13 miles. Charleston, Beaufort and Georgetown are ports of entry. The length of steam railways in the State is 3,824 miles (144 miles of double track) and 113 miles of electric railway. The chief roads traversing the State are the Southern (1,200 miles), the Atlantic Coast Line (880 miles) and the Seaboard Air Line (370 miles). The assessed value of the railroads is $45,816,096.

Banks and Banking.— A State bank of South Carolina was established in 1812 and was entirely under State control. It was the repository for all State funds. It went into liquidation during the Reconstruction period. There are now within the State 55 national banks, capitalized at $7,500,000 and with $22,000,000 on deposit; 285 State banks, capitalized at $10,500,000 and with $10,000,000 on deposit and $50,000,000 on loan; 28 savings banks, with 36,398 depositors, who have to their credit $9,676,647, or $265.05 to each depositor.

Constitution and Government.— From 1670 to 1719 South Carolina was governed under the Carolina provincial charter of 1665. From 1719 to the period of the Revolution it was governed mostly by Crown commission. In 1776, 1778, 1790, 1865, 1868 and 1895 constitutions were adopted. That of the last-named year has since been several times amended. A constitutional amendment may originate in either house of the legislature; if carried by a two-thirds vote in both houses it is submitted to the people at the next election following when a favorable majority sends it back to both houses, where it is again put to a vote. A majority vote of both houses is this time sufficient to make it part of the constitution. The two first steps above given for an amendment are also required to call a convention for the revision of the constitution. A negro majority is carefully guarded against by the constitutional provisions that voters applying for registration after 1898 must be able to read and write any section of the State constitution or must show that they have paid all taxes for the previous year on property appraised at $300 or over. This provision effectively bars illiterate negroes from voting and also all negroes who do not own real or other property assessed by the State at $300 or over. A residence of two years in the State is required for voting.

Executive.— The governor holds office for two years, is paid $3,000 and is eligible to succeed himself. He must be 30 years old, as also the lieutenant-governor, and both must be residents of the State for five years. Other executive officers are the secretary of state, comptroller, state superintendent of education, treasurer, commissioner of agriculture, commerce and industry and the attorney-general. All executive officers are elected for a term of two years and at the same time as the governor.

Legislative.— The State legislature is known as the general assembly. It is composed of a senate of 44 members, elected for four years (half retiring biennially), and a house of representatives of 124 members, elected for two years. Annual sessions are held beginning on the second Tuesday of January.

Judiciary.— The judicial power is vested in a Supreme Court, two Circuit Courts, a Court of Common Pleas with civil jurisdiction and a Court of General Sessions. The Supreme Court has a chief justice and four associates, elected by the general assembly for 10 years. The eight circuit justices are elected by the same body but for a four-year term. Justices of the peace are appointed by the governor.

Local Government.— The county is the unit of local government. It must contain at least one one hundred and twenty-fourth of the population of the State, have property assessed at $1,500,000 or over and be at least 400 miles in extent. The local electors must sanction all civic incorporation by a two-thirds vote.

Miscellaneous Laws and Provisions.— A provision of the constitution is aimed to prevent lynching, by providing for the removal from office of any officer who permits a prisoner to be seized and lynched, and by making such officer ineligible to hold any office of trust in the State. The county where the lynching occurs is liable in damages of not less than $2,000 to the legal representatives of the person lynched. Divorce is not allowed in any circumstances. Hours of labor in cotton and woolen mills are limited to 60 per week, with certain exceptions. No one may hold office under the constitution who denies the existence of the Supreme Being.

Finances.— The State derives its revenue from the general property tax, fees, licenses, phosphate royalties, etc. On 1 Jan. 1918 the balance on hand in the State treasury amounted to $963,089; the receipts in 1918 totaled $5,760,234. The expenditures in 1918 amounted to $5,904,786, leaving an unexpended balance on 1 Jan. 1919 of $818,537. On 1 Jan. 1919 the outstanding debt amounted to $5,391,320. The assessed value of real property in 1918 was $208,348,279; of personal property, $113,745,256.

Education.— School attendance is not compulsory, but there are certain restrictions on the employment of illiterate children in factories or mines. There are separate schools for white and colored children. There are 14,919 public schools in the State with 407,940 enrolled pupils and 8,680 teachers. The 149 public high schools have 427 teachers and over 8,000 pupils. For the training of teachers there is one public normal school with 67 teachers and 974 students. For higher instruction there is the University of South Carolina, founded at Columbia in 1805, with 43 professors and 385 students. Clemson Agricultural College has 71 professors and 840 students. Allen University (African Methodist Episcopal) for colored students has 17 professors and 631 students. Other higher institutions are Charleston City College, Erskine College (A. R. Presbyt.) and Wofford College (M. E. So.), at Spartanburg. There are several smaller denominational colleges and also eight colleges for women. There is also a college for colored youths, a military academy and a normal and industrial college. The expenditures on public school education in 1917 was $3,887,295.

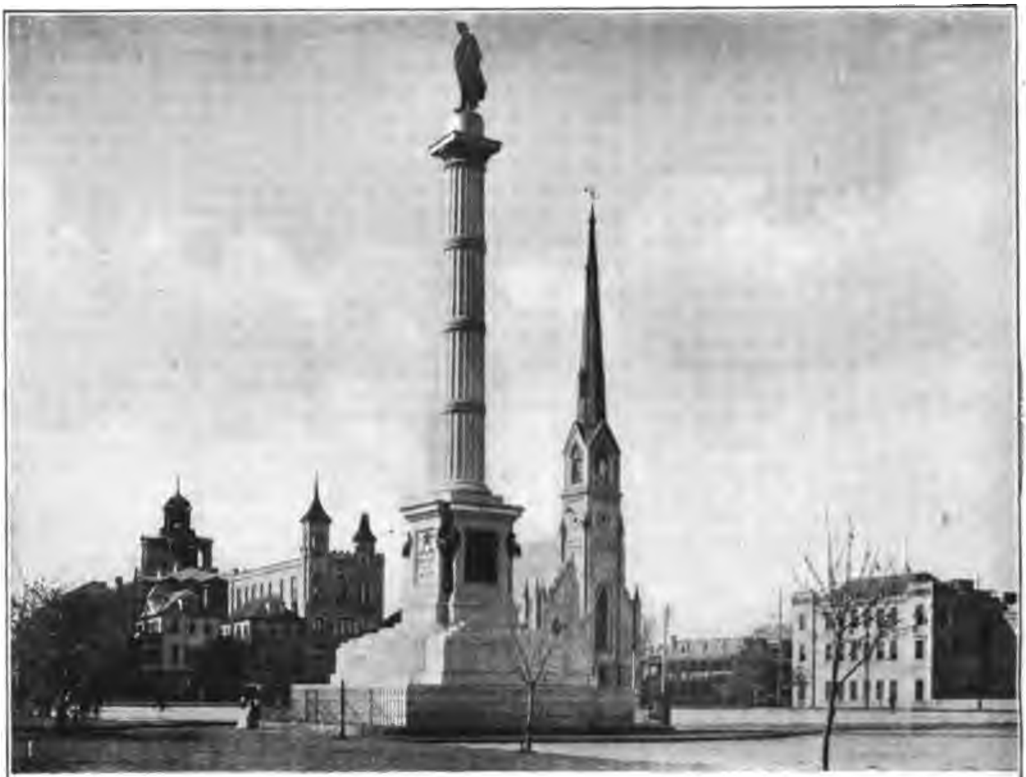
The State has a higher percentage of illiterates than all other States except Louisiana. Of the total population of 10 years of age or over 25.7 per cent were returned as illiterate at the last census. Among whites of native parentage the percentage of illiteracy was 10.5; among negroes, 38.7. The State educational system is ruled by a State Board of Education, under which are county superintendents, county boards and county supervisors.

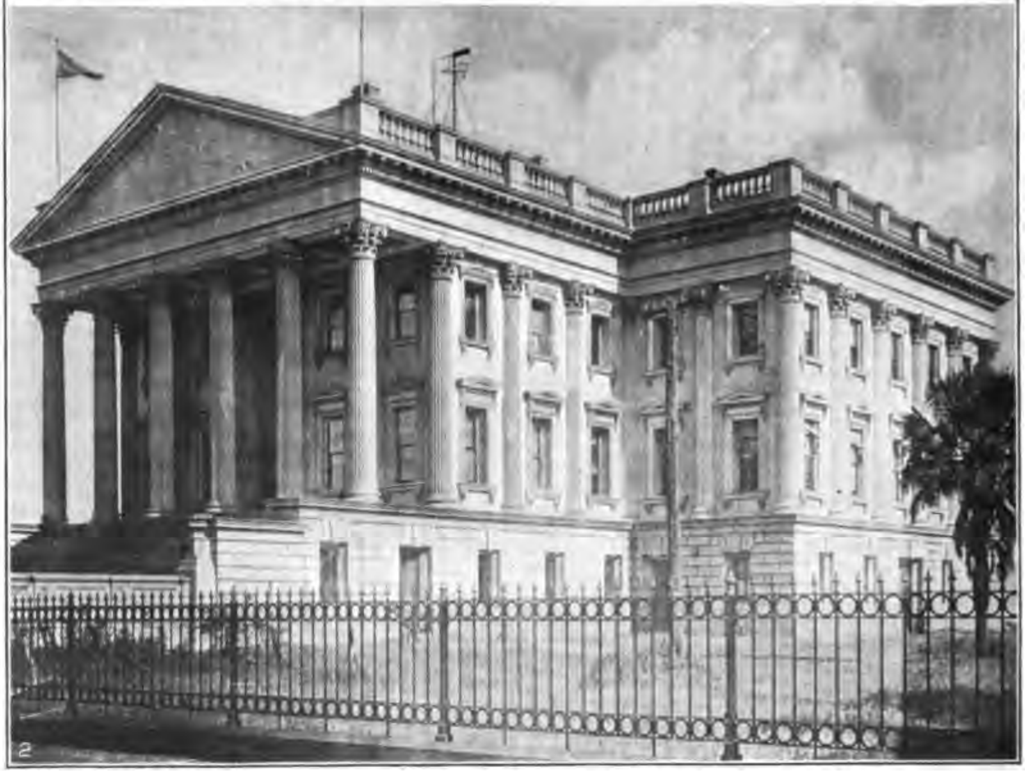
Population.— On 1 July 1918 the population was estimated at 1,660,934. In 1910 there were 679,557 whites, 835,843 negroes, 65 Asiatics and 331 Indians. The foreign-born population was 6,179, of whom 1,744 were German, 786 Russian, 767 Irish and 517 English. Large towns are Charleston with an estimated population of 61,041; Columbia, the State capital, 35,165; Spartanburg, 21,985, and Greenville, 18,574. There were 335,046 males of voting age in 1910 and of these 165,769 were whites.

Religion.— The last religious census returned 655,933 members of different religious denominations; the Baptists being strongest with 341,456 members, the Methodists next with 249,169. There were 35,533 Presbyterians, 12,652 Lutherans, 10,317 Roman Catholics and 8,557 Episcopalians.

Charities and Corrections.— The State maintains several charitable institutions, including a hospital for the insane at Columbia and an asylum for the deaf, dumb and blind. There are besides 9 orphanages, 10 hospitals and 10 homes for adults and children maintained mainly by private charity. A State Board of Charities and Correction was created in 1915. There is a State penitentiary at Columbia, where there is also a reformatory for negro boys. A State farm is located at Boykin and an industrial school at Florence.

1 The Capitol Building at Columbia
2 The First Baptist Church, Columbia, where the Ordinance of Secession was passed





1 The Calhoun Monument, Charleston

2 The Custom House at Charleston

History.— The first settlement on the continent of North America took place 27 May 1562 on the southeastern extremity of Paris Island in Port Royal Harbor. A colony of French Huguenots landed there and built a fort, naming it in honor of their king, Charles IX, Carolina (aboriginal name, Chicora). Their ships having returned to France for reinforcements, a fire broke out, which destroyed their barracks and magazine. In this plight they constructed boats, with the assistance of the Indians, and went back to France. In 1665-69 Charles II, of England, claiming Carolina by reason of the discovery of North America by John Cabot, in 1497, when sailing under a patent from Henry VII, granted all that "tract of ground" in America between the 36th degree and 31st degree north latitude, and to the west as far as the South Seas (Pacific Ocean) to eight English noblemen as Lords Proprietors. The grant covered about 1,020,000 square miles or more than one-third the area of the present United States, a region since largely peopled from the South Carolina of to-day. The first colony sent out landed in 1670, as the French had, at Port Royal, but removed shortly after to the confluence of the Ashley and Copper rivers, where they founded the city of Charleston. The Proprietary government was conducted under a royal charter and certain "Fundamental Constitutions" drawn for that purpose by the famous metaphysician, John Locke. In order to avoid "erecting a too numerous democracy" Locke designed a territorial aristocracy of landgraves, caciques and barons. The colonists, however, insisting upon the clause of the king's charter directing the Lords Proprietors to "govern according to their best discretion by and with the advice, assent and approbation of the Freemen of said territory, or their deputies or delegates," prevented from first to last this aristocracy from taking root in the colony. The Proprietary government, without adaptability to the circumstances and necessities of the colony, promoted endless discussions and dissensions as to the interpretation of the charter and the "Constitutions." A succession of "heats and broils" during 49 years culminated in 1719. The Proprietors expressed their inability to aid the colonists, refused petitions addressed to them on important matters and repealed acts of the assembly laying taxes for the discharge of the public debt and for the freedom of elections. The assembly thereupon voted itself a convention and unintimidated by the threat of the Proprietary governor to bombard Charleston from a British war vessel, elected James Moore governor in the name of the king, and the Royal Government of the Province supplanted that of the Proprietors.

Bancroft and Dana place the highest estimate of the aborigines south of the Great Lakes and east of the Mississippi River at 180,000, or one person to four and one-half square miles, a territory now supporting a population of 67 to the square mile, or 301 for one Indian. John Lawson 1703 and Governor Glen in 1743 agree in estimating the Indian population of Carolina at about one to eight square miles. They were generally friendly to the colonists except when incited to sudden outbursts of hostility by the Spaniards, the French or the British, and formed a more or less important contingent in war, as when James Moore in 1702-03 invaded the Appalachian region with 25 whites and 1,000 Indians and returned with 1,300 captives, who were sold into slavery to the northern colonies and the West Indies.

Negro slaves were introduced from the Barbadoes in 1671 and were counted to be 12,000 in number at the close of the Proprietary rule in 1720. They were instructed in the Christian religion and some of them taught to read. It was required of each white militia man that he should train and arm a negro to accompany him in war. The white population had increased from 391 in 1671 to 9,000 in 1720, living chiefly in proximity to Charleston. While the Indians lived principally on game and fish, cultivating only two plants, corn and tobacco, both exotics, the white colony never suffered for subsistence. They got 30 to 80 bushels of corn from an acre, deer supplying meat; an Indian hunter would for $25 a year furnish a family with 100 to 200 deer, besides wild turkey, fish, etc. The culture of rice was introduced in 1693 and the export of this cereal in 1720 amounted in value to £3,350 sterling. The Proprietors refused in 1674 to send out cattle to the colonists, saying they wanted them to be "planters and not graziers," but seven years later they had so increased that many planters had 700 to 800 head. The assembly had to appoint commissioners to dispose of unmarked animals, and passed a law for the enclosure of crops, which remained in force until 1882.

As early as 1700 Charleston had a large and lucrative trade with the Indians in furs and hides, extending 1,000 miles into the interior, and a large export trade in forest products, timber, pitch, turpentine and provisions to the northern colonies and the West Indies. Religious freedom was secured, while the ministers of the Church of England were supported from the public funds. The various Church members stood as follows: Episcopalians, 42 per cent; Presbyterians and Huguenots, 45 per cent; Baptists, 10 per cent; Quakers, 3 per cent. A free public library was established in Charleston in 1700 and a free school in 1710. In 1712 a digest of the English and colonial laws was prepared by Chief Justice Trott. In 1717 a successful war was waged against the pirates infesting Cape Feare and a number of them captured and executed. A duty of £30 a head was laid on the importation of negroes.

George I and George II were nursing fathers to Carolina. The assembly was convened, all actions at law on account of the change of government were declared void and the judicial proceedings under the provisional administration confirmed. Treaties were made with the Indians, who had hitherto stood as independent neighbors and were now constituted allies or subjects. Parishes were laid out and whenever settled by 100 families, they were allowed representation in the assembly. To relieve the burden on the country people of repairing for the trial of all causes to the general court at Charleston, county and precinct courts were established. Schools were established in each precinct and £25 levied by the justices to assist in the yearly support of the teachers, who were required to teach 10 poor children free of charge. Between 1733 and 1774, over 200 tutors, schoolmasters or schoolmistresses, were engaged in the province. The king having bought out the Proprietors for £17,500 purchased also the quitrents due them by the colonists and remitted them. Charleston was the extreme southwestern outpost of the British in America. As late as 1741, when the Spanish possessions lay embosomed on the Gulf of Mexico, with Saint Augustine, the oldest fortified place in America, the French claimed all the territory lying west of a line starting from a point north of Charleston, reaching the Appalachian Mountains, running round the headwaters of the Potomac, across the Mohawk and Hudson, down Lake Champlain and by the Sorel River to the Saint Lawrence. With little aid from the mother country, the colonists had stood as the advance guard against the warring Europeans and held in check the American savages, the African savages imposed upon them, and the pirates. The first settlers had confined themselves to the neighborhood of Charleston. Now the settlement of Georgia, 1732–34, protected the Western frontier and the interior of Carolina, received many immigrants, Germans, and after Culloden many Scotch came into the middle section, and, on Braddock's defeat, refugees from Virginia and Pennsylvania followed in the Piedmont region. Land was granted free of charge for 10 years and after that the annual rental was four shillings sterling for 100 acres. Great Britain imposed restrictions on the commerce and domestic manufactures of her colonies. While this was prejudicial to the more northern colonies, it did not affect an agricultural people like the Carolinians. The restraint imposed by the navigation acts on colonial exports was removed on the export of Carolina rice. The exports of rice and indigo reached £108,750 in 1747. In 1775 the exports of these two commodities alone were valued at £1,000,000 sterling, a third of what the entire trade of the American colonies was estimated at in 1768. Between 1725 and 1775 the population increased sevenfold. In 1773 Josiah Quincy, writing from Charleston, says of the city: «In grandeur, splendor of buildings, equipages, commerce, number of shipping, and, indeed, in almost everything, it far surpasses all I ever saw or expected to see in America.» With the most sincere and loyal attachment to Great Britain, the king and his government, the Carolinians sent their children to England and Scotland to be educated and spoke of the mother country as «home.»

In the midst of this prosperity Carolina was led, step by step, during a period of 11 years, through sympathy with the northern colonies for injuries inflicted on them, to take part against the enforcement by Great Britain of taxation without representation, without desiring or anticipating the separation from that country, which finally took place. On 28 June 1776, while the congress of the colonies was discussing the Declaration of Independence, Colonel Moultrie, from the Palmetto Fort on Sullivan's Island, repulsed with heavy loss the English fleet and turned back the expedition of Sir Henry Clinton for the invasion and subjugation of the South. In the same year Carolina was the first colony to frame and adopt an independent constitution, but with the proviso that this constitution is but temporary «until an accommodation of the unhappy differences between the colonies and Great Britain can be obtained.»

In 1778 John Rutledge, governor of the State, declared «such an accommodation, an event as desirable now as it ever was.» The material injuries to Carolina by the Stamp Act, the duty on tea and the other acts of the government of George III were slight as compared with the advantages she enjoyed under English rule, but she had enlisted in no lukewarm manner in the struggle on account of the principles of right and justice involved. It was not until after the fall of Charleston in 1780, when the State lay prostrate, that the outrages of the British armies roused to resistance the population from the seaboard to the mountains. They then flocked to the standards of the partisan leaders, Marion, Sumter, Pickens and others, and so harassed and delayed the northward movement of Cornwallis to join Clinton that Washington and Lafayette were enabled to unite in Virginia and force the British into Yorktown. There, blockaded by the French fleet under DeGrasse, they were compelled to surrender and the war virtually terminated in favor of the Americans. Carolina contributed $1,205,978 above her quota to this war — only a few thousands less than Massachusetts, whose war the Revolution was, and who never suffered from invasion — and more than all the other 11 colonies together. One hundred and thirty-seven engagements with the British took place within her borders. In 103 Carolinians alone fought, in 20 others she had assistance and 14, including Camden, were fought by troops from other colonies. «Left mainly to her own resources,» says Bancroft, «it was through the depths of wretchedness that her sons were to bring her back to her place in the republic after suffering more, daring more, and achieving more than the men of any other State.»

The eight years of war were followed by eight years of distress and disorganization. The country had been laid waste, churches burned and industries paralyzed. It was estimated that the British had kidnapped 25,000 slaves and sold them. They plundered the planters' homes. Bancroft says they pillaged of plate alone to the value of £300,000. After the fall of Charleston there arose a 14-years' dispute between the army and navy engaged in the siege as to their respective shares of the plunder. On 9 Aug. 1787 Carolina ceded to the United States her lands (10,000 square miles), not lying within her present boundaries. On 17 September of the same year she ratified the Constitution of the United States. In 1790 the seat of government was removed from Charleston to Columbia, in the the centre of the State, and another constitution substituted for that of 1776. An amendment in 1808 fixed the number of representatives at 124, allowing one representative for each 62d part of the white inhabitants and one for each 62d part of the taxes raised by the legislature. The senate was to be composed of one member from each election district, except Charleston, which was allowed two. This accentuated the differences already existing between the peoples of the lower and the upper country. The former, being the outgrowth of the city life of Charleston and the first settlers, preponderated in wealth. The other, arising from numerous and separate centres of rural settlement, had the larger and more rapidly increasing number of white inhabitants.

The first Tariff Act of 1789 imposed an ad valorem duty of 5 per cent on imports (with a few specific duties of 15 per cent) for the support of the Federal government. This was in addition to the taxes raised by each State for its own purposes. It was much higher taxation than under the colonial government, which required in ordinary times only a duty of 3 per cent on imports, with an export duty of *3d.* on hides. Four years later the tariff was raised to 10 and 20 per cent. Ten years after, duties were increased 2½ per cent in aid of the Mediterranean Fund against the Barbary Powers. Double war duties, amounting to 25 to 40 per cent, were imposed in 1812. In 1816 a tariff protecting the industries, that had been found necessary but deficient during the late war, fixed duties at 25 per cent, to be reduced to 20 per cent in 1820. The Carolina representatives supported this not unreasonable protection. The reduction never took place, and at this the Carolina representatives protested. Disregarding their protest, a tariff imposing 12 to 50 per cent duties was passed in 1824. Again, in 1828, without regard to the complaints of the Carolina farmers, who were being forced to contribute to the manufacturing profits of other States, a tariff raising duties 25 to 50 per cent was enacted. Wearied with unavailing remonstrance, a convention of the people of Carolina was called in 1832, which declared the protective tariff law unconstitutional, null and void. To meet this action of the State, Congress passed the Force Bill in 1833 for the collection of customs. In the same month of the same year Congress passed «the Clay Compromise Act» for a gradual reduction of duties until 1842, when they should reach a 20 per cent level. This restored tranquillity, although for the second time the promised reduction was never fully realized.

Coincident with the tariff, another and more serious source of disturbance arose. In 1775 slavery extended over North America from Canada to Florida, inclusive. It had been introduced by Queen Elizabeth, and James II belonged to the Royal African Company for trading in negro slaves. Now it began to be looked upon with horror, as something strange and foreign to human instincts. The New England Anti-Slavery Society was formed in 1832. In less than four years more than 100,000 persons had joined anti-slavery societies in the Northern and Western States. They demanded of Congress that «all slaves should be instantly set free without compensation of the owners.» They declared «we will give the Union for the abolition of slavery.» The lesson was taught far and wide that the slaveholders of the South «a few arrogant domineering self-constituted aristocracy» were — through the representation allowed them «in proportion to the number of their slaves»— ruling the work-people of the North and denying their industries the protection due from the Federal government. They declared that «the country must become all free or all slave.» The non-slaveholding whites of the South were as violently opposed to the emancipation of the negroes as their brethren of the North were in favor of it. To them it meant industrial, political and social equality with a people in their midst whom they deemed inferior to themselves. They did not ask for aid to their industries through Federal taxation and did not see why Northern manufacturers should. After years of angry discussion along these lines the crisis came — during a period of unprecedented prosperity in Carolina — on the election by the Anti-Slavery party of a President in 1860 by less than a third of the popular vote. It found the peoples North and South solidly arrayed against each other with fatal unanimity. The «irrepressible conflict» burst into war. The North took the offensive for Federal domination and patronage and for race equality, freedom and fraternity. They were sustained by the popular sentiment of the European masses. South Carolina and the South rose to a man — with no sympathy or support from without — in defense of State autonomy and white supremacy. From an arms-bearing population of 55,046 in Carolina 44,000 volunteered (most of them not identified with the slave-holding class) in defense of the domestic institutions of the State, its sovereignty and free trade. Utimately 71,088 were mustered in.

Poorly armed, poorly clad, poorly fed, practically without pay for more than four years they maintained their cause, losing in battle and by disease 15,638 of their number. The negroes, who, in earlier days, had been enticed away by promises from the Spaniards and had sometimes sided with the Tories and the British, remained as a rule loyal to their masters in this war, served their families and tilled their fields, while they were absent. The issue was decided by force of arms and numbers and was never submitted to legal adjudication. No indictments for treason, as is usual in rebellions, were made. An export duty was placed on cotton and import duties were increased by the national government. For 12 years negro supremacy was enforced in the State by the Federal army. When on 10 April 1877 the Federal guard filed out of the south door of the Capitol at Columbia the negro government collapsed without a struggle. The white citizens quietly resumed the administration of affairs. President Eliot of Harvard, in a speech before the Central Labor Union in Boston February 1904 on the world-wide conflict of labor and capital, sums up the result of this titanic struggle in these words: «How many things my generation thought were decided at Appomattox; but during the subsequent 40 years it has gradually appeared that hardly anything was settled there except the preservation of the unity of the National territory.» For more than two centuries, under 10 written constitutions, the State had been governed by a more than usually centralized democracy. Opposing a similar centralization of functions by the Federal Union, the collision dispersed these functions into smaller and smaller civil divisions; counties, townships, school districts. The latter, restricted to an area of 9 to 40 square miles, were endowed with the sovereign power to lay taxes and incur debt. A centrifugal tendency is noticeable, also, in subdivision of farms, and in the establishment of cross-road stores and village banks.

After the withdrawal of troops by President Hayes the whites secured control and white supremacy has since been maintained. In 1886 a property loss of $8,000,000 was caused by a severe earthquake centring about Charleston. Over 1,000 persons perished in a great storm along the coast in 1893. The gubernatorial contest of 1890 was most bitter between the so-called aristocrats and the plebs or Farmers' Alliance. The latter were victorious and elected their candidate, Ben Tillman, to the governorship. Liquor regulation and legislation caused serious political turmoil from 1893 to 1907 when the State liquor dispensaries were abolished because of charges of corruption. In 1910 Prohibition was a campaign issue and went down to defeat when Coleman L. Blease was elected governor. Blease was soon involved with the State Supreme Court over judicial nominations, refusing to commission any judicial appointees other than his personal friends. About 1911 the governor began to pardon convicts wholesale, and by the end of his second term had considerably depleted the prison population. He also exercised his veto to an extraordinary degree but very many acts were passed over his veto. Despite considerable opposition Blease was re-elected in 1912. On 11 Jan 1915 Blease disbanded the organized militia and resigned the following day. His successor reversed the order of disbandment. The State voted a majority for Prohibition in 1915. The State is strongly Democratic, having consistently voted a Democratic majority, except during the Reconstruction period, 1866–77, when Republicans were in power.

Population.— After the Revolutionary War the population of South Carolina was estimated at 104,000 for representation in the Federal Congress. In 1790 the State ranked seventh; it rose to sixth in 1800–10–20. The decline in rank commencing at the latter date has been continuous, and in 1910 the State ranked 26th. In 1790 the density per square mile was 8.3; in 1910 it was 49.7. The foreign-born population was only 4 per cent of the whole in 1900; at that date the State had lost to other States 233,300 persons born in its limits, and had received from all the others 55,216, making a net loss from interstate migration of 178,076. The population in 1910 was 1,515,400.

GOVERNORS OF SOUTH CAROLINA.

PROPRIETARY PERIOD, 1670–1719.

Sir John Yeamans	1665
William Sayle	1669–70
Joseph West (acting)	1670–72
Sir John Yeamans	1672–74
Joseph West	1674–82
Joseph Morton	1682–84
Richard Kyrle	1684
Robert Quarry (acting)	1684–85
Joseph West	1685
Joseph Morton	1685–86
James Colleton	1686–90
Seth Sothell	1690–92
Philip Ludwell	1692–93
Thomas Smith	1693–94
Joseph Blake (acting)	1694
John Archdale	1694–96
Joseph Blake	1696–1700
James Moore (acting)	1700–02
Sir Nathaniel Johnson	1702–10
Edward Tynte	1710
Robert Gibbes (acting)	1710–11
Charles Craven	1711–16
Robert Daniel (deputy governor)	1716–17
Robert Johnson	1717–19

ROYAL PERIOD, 1719–76.

James Moore	1719–21
Sir Francis Nicholson	1721–25
Arthur Middleton	1725–29
Robert Johnson	1729–35
Thomas Broughton (deputy)	1735–37
William Bull (lieut.-gov.)	1737–43
James Glen	1743–56
William Henry Lyttleton	1756–60
William Bull, the 2d (lieut.-gov.)	1760–61
Thomas Boone	1761–64
William Bull, the 2d (lieut.-gov.)	1764–66
Lord Charles Greville Montague	1766–68
William Bull, the 2d (lieut.-gov.)	1768
Lord Charles Greville Montague	1768–69
William Bull, the 2d (lieut.-gov.)	1769–71
Lord Charles Greville Montague	1771–73
William Bull, the 2d (lieut.-gov.)	1773–75
Lord William Campbell	1775
Henry Laurens (Pres. Council Safety)	1775–76

STATEHOOD PERIOD, 1776.

John Rutledge		1776–78
Rawlins Lowndes		1778–79
John Rutledge		1779–82
John Matthewes		1782–83
Benjamin Guerard		1783–85
William Moultrie		1785–87
Thomas Pinckney		1787–89
Charles Pinckney	Dem.-Rep	1789–92
William Moultrie	“	1792–94
Arnoldus Vanderhorst	“	1794–96
Charles Pinckney	“	1796–98
Edward Rutledge	“	1798–1800
John Drayton	“	1800–02
James B. Richardson	“	1802–04
Paul Hamilton	“	1804–06
Charles Pinckney	“	1806–08
John Drayton	“	1808–10
Henry Middleton	“	1810–12
Joseph Alston	“	1812–14
David R. Williams	“	1814–16
Andrew Pickens	“	1816–18
John Geddes	“	1818–20
Thomas Bennett	“	1820–22
John L. Wilson	“	1822–24
Richard I. Manning	“	1824–26
John Taylor	“	1826–28
Stephen D. Miller	Democrat	1828–30
James Hamilton, Jr	“	1830–32
Robert Y. Hayne	“	1832–34
George McDuffie	“	1834–36
Pierce M. Butler	“	1836–38
Patrick Noble	“	1838–40
B. K. Henegan (acting)	“	1840
John P. Richardson	“	1840–42
James H. Hammond	“	1842–44
William Aiken	“	1844–46
David Johnson	“	1846–48
Whitemarsh B. Seabrook	“	1848–50
John H. Means	“	1850–52
John L. Manning	“	1852–54
James H. Adams	“	1854–56
Robert F. W. Allston	“	1856–58
William H. Gist	“	1858–60
Francis W. Pickens	“	1860–62
Milledge L. Bonham	“	1862–64
Andrew G. McGrath	“	1864–65
Benjamin F. Perry	Provisional	1865
James L. Orr	Conservative	1865–68
Gen. Ed. R. S. Canby	Military	1868
Robert K. Scott	Republican	1868–72
Franklin J. Moses	“	1872–74
Daniel H. Chamberlain	“	1874–76
Wade Hampton	Democrat	1876–79
William D. Simpson (acting)	“	1879–80
Thomas D. Teter (acting)	“	1880
Johnson Hagood	“	1880–82
Hugh S. Thompson	“	1882–86
John C. Sheppard (acting)	“	1886
John P. Richardson	“	1886–90
Benjamin R. Tillman	“	1890–94
John G. Evans	“	1894–97
William H. Ellerbe	“	1897–99
Miles B. McSweeney	“	1899–1903
Duncan C. Heyward	“	1903–07
Martin F. Ansel	“	1907–11
Coleman L. Blease	“	1911–15
C. A. Smith (acting)	“	1915
Richard I. Manning	“	1915–19
Robert A. Cooper	“	1919–21

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J. B. McDonnell,
Editorial Staff of The Americana.

SOUTH CAROLINA INTER-STATE AND WEST INDIAN EXPOSITION, a commercial and industrial exhibition held at Charleston, S. C., from 1 Dec. 1901 to 1 May 1902, at which exhibits were made from nearly all the Southern States and from the West Indian Islands. The exposition showed the remarkable progress made by the South Atlantic States in commerce and industry since the Civil War. The cost of the exposition was $1,250,000, of which $313,000 was covered by the receipts. The total attendance was 674,086.

SOUTH CAROLINA UNIVERSITY. See University of South Carolina.

SOUTH DAKOTA, the «Sunshine State,» one of the north central United States located west of Minnesota and Iowa, north of Nebraska and east of Wyoming. It lies chiefly between the 97th and 104th degrees of longitude and the 43d and 46th degrees of latitude. This gives it an area of 77,615 square miles, being 360 miles wide from east to west and about 225 miles from north to south. It is the 14th State of the Union in respect to area. The word Dakota is of Indian origin and means «leagued or allied.»

Geology and Topography.— South Dakota has very great extremes of altitude and a great variety of topography. Big Stone Lake, in the northeastern part, is its lowest point. This is less than 1,000 feet above sea-level (967), while in the southwestern portion of the State, known as the «Black Hills,» there are elevations which rise to over 7,000 feet. Harney Peak is given at 7,244 feet by best authorities. The surface also varies from that of level plains, which may be found in the James River Valley and along the Missouri, to high table-lands with gentle undulations, as east of the Missouri and in smaller areas on the summit of the Coteaus. Then there is a region of narrow cañons, hundreds of feet in depth, presenting on a smaller scale the wildness and picturesqueness of the Rocky Mountains, as Elk Creek and Spearfish cañons in the Black Hills and the rugged, craggy needles of Harney Peak and vicinity. There are areas in the State where you cannot find a stone the size of an egg for a score of square miles and other sections where rocks and stones may be found in great abundance — where erosion went on so continuously as to produce barren conditions. The Bad Lands of White River are a good illustration of this formation. The surface may be classified as follows: (1) The Black Hills: these are mountainous elevations — much eroded — dome-shaped peaks pushed up above the horizontal beds that cover the surrounding region (2) the Table Lands: these occupy the region just east of the Missouri chiefly and were formerly called by the French «Plateau du Coteau du Missouri»; (3) river valleys, including the present flood plains and also higher terraces, such as the Missouri River, which divides the State in nearly two equal parts, the Cheyenne, White, James and Sioux River valleys; (4) Bad Lands, a limited area in southwestern portion of the State, chiefly along the White River. This area has some unique characteristics. These several divisions require further description to be appreciated. The Black Hills district has an area of about 5,000 square miles and occupies a prominent position in the southwestern corner of the State. Their true limits are distinctly marked by a sharp ridge of sandstone from 300 to 600 feet in height. This ridge is separated from the higher mass of hills by a valley from one to three miles in width, known as Red Valley, so named by the Indians from the brick red soil found there, From this valley one ascends gradually the outer slope of the hills proper and soon enters an altitude of 4,000 to 5,000 feet. This outer slope presents great variety of soil formation. It is underlaid by older sedimentary rocks cut in all directions by narrow and deep cañons. This feature applies to all the southwestern portion of the State. From the broken interior edge of this slope (this sedimentary plateau) one descends a bluff and enters a central area of slates-granite and quartzites formation. These are in many places carved into high ridges and sharp peaks cut by numerous narrow and deep valleys and ravines and with thickly-set Rocky Mountain pine timber. Toward the south of this elevated plateau Harney Peak rises to 7,244 feet above sea-level and toward the north Terry and Custer peaks attain quite an altitude and present a rugged and interesting surface.

The Table Lands correspond approximately to the early surface of the State. They slope from an altitude of about 3,500 feet along the western boundary eastward to an altitude of 2,000 feet near the northeast corner and to 1,450 feet near the southeast corner. This makes an average slope eastward of about four feet per mile along the northern boundary and less than six feet along the southern boundary. The highlands are eroded into undulations and traces are present of higher strata which every here and there stand out as buttes and ridges. The region which best illustrates this peculiarity is the northern part of that district lying west of the Missouri River. On the east side of the river these highlands are less prominent and yet may be readily located. The Bijou Hills, Wessington Hills, Ree Hills, etc., are all of this same formation as are the Choteau Creek Hills and Turkey Ridge in the southern portion of the State. There are three very important valleys crossing the State from north to south. These are the Missouri, the James and Big Sioux. The Minnesota also touches the northern portion of the State where it has an altitude of about 1,000 feet above the sea. The James River Valley is from 60 to 70 miles wide and from 1,200 feet high at about the northern boundary line to 100 feet at the southern line. It has five important branches. One extends west from Aberdeen at an altitude of about 1,500 feet, another west from Scotland and the fourth southeast from Marion. The fifth is northeast from Aberdeen and connects this James Valley with the Minnesota. All of these valleys have been very much eroded by glacial movements and are less sharply defined than are the valleys west of the Missouri River. The Missouri River Valley is very narrow, usually less than three miles in width in South Dakota. Its western tributaries are also marked by narrow cañon-like valleys. Examples of this are the Grand, the Cheyenne and White River cañons. Along all of these Western rivers may be found a similarity of formation quite unique and presenting many features of interest to the student of nature. On the extreme eastern side of the State, extending nearly the entire length of the same and forming for nearly 100 miles the eastern boundary, is the big Sioux River Valley. This embraces the best agricultural soil in the State and is not surpassed in fertility by any State in the Union.

The Bad Lands.— These have become famous. Their features and treasures early attracted the hunter and the explorer. The term «bad» has been applied to them because of the difficulty of exploring that region. The most notable «bad lands,» or *mauvaises terres* in the State are located between the Cheyenne and White rivers. This whole region is cut up by deep ravines, bounded largely with high continuous clay bluffs. Most of the surface is without useful vegetation. The peaks and bluffs seem to have been carved by erosion out of the white clays, marls and sands of the Tertiary Geological Period. The «Bad Lands» have become widely known, chiefly through the fossil remains they contain. The most fruitful field for this is what is known as Indian Draw, a south branch of the Cheyenne River. Here the stream has eroded a valley five or six miles in width, bounded by steep cliffs over 300 feet high. This valley is studded with an indescribable labyrinth of buttes, ravines, grassy valleys and dry water courses. Here the light colored clays of the Tertiary Period rest directly on the dark Cretaceous shales. In the lower strata of the Tertiary are to be found the best fossil remains. Many of these have found their way into our best European museums and are evidences of mammoth animals of various types that once inhabited the forests of the State.

Archæological Remains.— The State also contains interesting archæological remains. These indicate the occupancy of a prehistoric race of greater industry and intelligence than the Indians later encountered by the white man. One of these is the remains of a strong fort near Pierre. It embraces about 130 acres of ground, is admirably located for strategic purposes, is laid out with a skill and accuracy that challenges the admiration of modern military engineers. Within this are found remnants of pottery which give evidence of a high degree of skill and artistic sense. Copper instruments, highly tempered, are also found indicating an art now lost to man. The walls of the fortification are very heavy and well constructed, suggesting an industry and a skill never exhibited by any Indian tribes. There are similar fortifications at several other strategic points in the State, such as Chamberlain and Campbell County. Near old Fort Wadsworth, in Marshall County, are also extensive mounds which army engineers long ago pronounced must belong to a prehistoric race.

Climate and Rainfall.— The State is noted for its abundance of sunshine. The whole eastern slope of the Rocky Mountain Plateau is distinguished for its sunshine and South Dakota is known as the «*Sunshine*» *State.* No Northern State has fewer cloudy days. The air is dry in winter and a low temperature is endured without much suffering. The Chinook winds from the Pacific warm current modify the temperature very perceptibly, especially in the western part of the State. The temperatures vary from an average of 16° above zero for January (the coldest month) to an average of 72° for July (the warmest month). The growing season varies from 136 days in the Black Hills to 150 days in the southeastern

SOUTH DAKOTA.

Estimated population, 698,509

COUNTIES

Pop. 1915		
231	Armstrong	D 8
6,736	Aurora	F 12
16,061	Beadle	E 13
1,488	Bennett	G 6
11,560	Bon Homme	H 14
15,544	Brookings	E 16
25,969	Brown	B 13
6,376	Brule	F 11
*1,485	Buffalo	E 11
5,894	Butte	D 2
4,888	Campbell	B 9
*14,790	Charles Mix	G 12
10,670	Clark	D 14
9,214	Clay	H 16
15,192	Codington	C 15
3,272	Corson	B 7
3,452	Custer	F 2
13,005	Davison	F 13
*14,235	Day	C 14
8,529	Deuel	D 16
*1,933	Dewey	C 8
6,639	Douglas	G 13
6,845	Edmunds	C 11
6,027	Fall River	G 2
5,265	Faulk	C 11
10,474	Grant	C 16
11,919	Gregory	G 11
3,553	Haakon	E 6
7,791	Hamlin	D 15
7,286	Hand	E 11
6,316	Hanson	F 14
4,821	Harding	B 2
*5,055	Hughes	E 9
13,095	Hutchinson	G 14
2,685	Hyde	D 10
2,077	Jackson	F 6
5,275	Jerauld	F 12
.....	Jones (Pop. included in Lyman Co.)	F 8
11,947	Kingsbury	E 15
11,865	Lake	E 15
17,710	Lawrence	D 2
13,564	Lincoln	G 16
*7.412	Lyman	F 9
10,013	McCook	F 15
6,831	McPherson	B 11
8,328	Marshall	B 14
*8,724	Meade	D 4
*3,427	Mellette	F 8
8,007	Miner	E 14
37,613	Minnehaha	F 16
9,686	Moody	E 16
10,040	Pennington	F 3
7,641	Perkins	C 4
3,648	Potter	C 10
15,660	Roberts	B 16
7,377	Sanborn	F 13
.....	Shannon (Pop. incl. in Pine Ridge and Rosebud Ind. Reservations.)	G 4
14,977	Spink	D 13
2,251	Stanley	E 8
2,004	Sully	D 9
2,403	Todd	G 8
10,262	Tripp	G 10
14,636	Turner	G 15
11,436	Union	H 16
5,919	Walworth	C 9
.....	Washabaugh (Pop. incl. in Pine Ridge and Rosebud Ind. Reservations.)	F 6
.....	Washington (Pop. incl. in Pine Ridge Indian Reservation.)	G 4
14,851	Yankton	G 15
*2,571	Ziebach	D 6

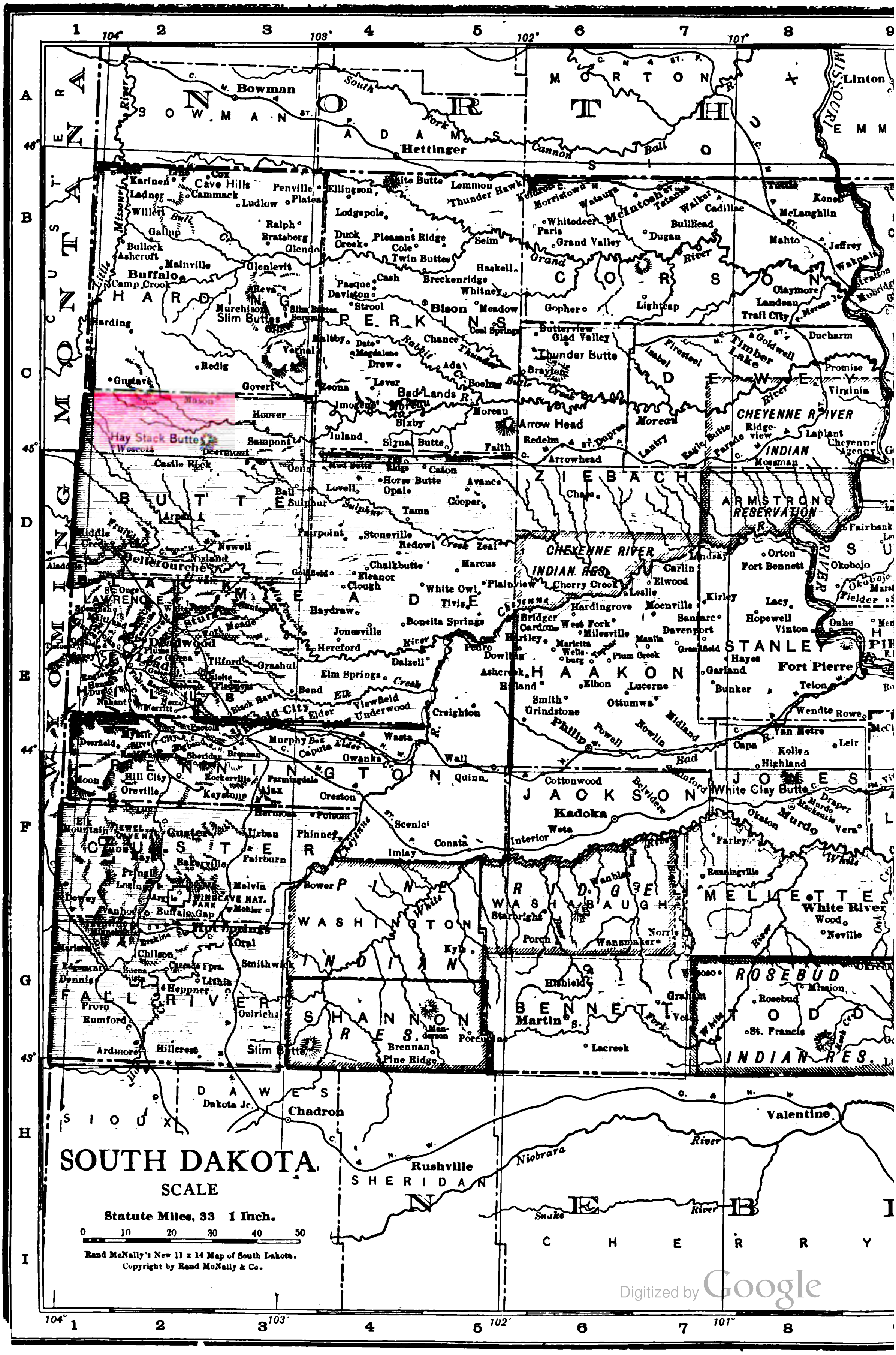
Indian Reservations

1,037	Cheyenne River	C 8
485	Crow Creek	E 10
.....	Lower Brule	E 10
6,315	Pine Ridge	F 5
.....	Rosebud	G 8

*Including Indians.

Incorporated Cities, Towns, Villages, Etc.

15,218	Aberdeen	C 12
76	Akaska	C 9
140	Albee	C 17
477	Alcester	H 16
936	Alexandria	F 14
394	Alpena	E 13
103	Altamont	D 16
349	Andover	C 14
140	Ardmore	G 3
884	Arlington	E 16
953	Armour	G 13
159	Artas	B 10
586	Artesian	E 14
326	Ashton	D 13
277	Aurora	E 16
525	Avon	G 14
306	Baltic	F 16
139	Bancroft	E 14
1,101	Belle Fourche	D 1
1,332	Beresford	G 16
652	Big Stone City	C 16
277	Blunt	E 9
532	Bonesteel	G 11
538	Bowdle	C 10
333	Bradley	C 14
224	Brandt	D 16
100	Brentford	C 13
971	Bridgewater	F 14
457	Bristol	C 14
907	Britton	B 14
114	Broadland	E 13
3,416	Brookings	E 16
328	Bruce	E 16
687	Bryant	D 15
137	Buffalo Gap	F 3
421	Burke	G 11
146	Bushnell	E 17
149	Butler	C 14
133	Camp Crook	B 2
511	Canastota	F 15
318	Canova	F 14
2,316	Canton	G 16
103	Carter	G 9
555	Carthage	E 14
537	Castlewood	D 16
192	Cavour	E 13
1,109	Centerville	G 16
262	Central City	E 2
1,055	Chamberlain	F 11
228	Chancellor	G 15
86	Chelsea	C 12
122	Claire City	B 15
279	Claremont Brown	B 13
1,200	Clark	D 14
804	Clear Lake	D 16
399	Colman	E 16
415	Colome	G 10
522	Colton	F 16
250	Columbia	B 13
483	Conde	C 13
301	Corsica	G 13
120	Cottonwood	F 6
238	Cresbard	C 12
86	Crocker	C 14
416	Custer	F 2
751	Dallas	G 11
113	Dante	H 13
244	Davis	G 16
3,113	Deadwood	E 2
1,538	Dell Rapids	F 16
494	Delmont	G 13
1,014	De Smet	E 14
515	Doland	D 13
133	Dolton	G 15
120	Draper	F 9
108	Dupree	C 6
78	Eagle Butte	C 7
743	Edgemont	G 2
605	Egan	F 16
1,546	Elk Point	H 16
768	Elkton	E 16
545	Emery	F 14
78	Englewood	E 1
232	Erwin	E 15
575	Estelline	D 16
308	Ethan	F 13
968	Eureka	B 10
391	Fairfax	G 12
151	Fairview	G 16
232	Faith	C 5
458	Faulkton	D 12
1,688	Flandreau	E 17
216	Florence	D 15
673	Fort Pierre	E 9
428	Frankfort	D 13
402	Frederick	B 13
725	Freeman	G 15
234	Fulton	F 14
59	Galena	E 2
254	Garden City	D 14
819	Garretson	F 17
591	Gary	D 17
320	Gayville	H 15
664	Geddes	G 12
751	Gettysburg	D 10
139	Glenham	C 9
126	Goodwin	D 16
919	Gregory	G 11
1,028	Groton	C 13
185	Harrisburg	G 16
173	Harrold	E 10
703	Hartford	F 15
256	Hayti	D 15
249	Hazel	D 15
474	Hecla	B 13
435	Henry	D 15
77	Hermosa	F 3
391	Herreid	B 9
445	Herrick	G 11
245	Hetland	E 15
700	Highmore	E 11
261	Hitchcock	D 13
301	Hosmer	C 11
2,132	Hot Springs	G 2
180	Hoven	C 10
1,169	Howard	F 15
435	Hudson	G 16
450	Humboldt	F 15
531	Hurley	G 15
6,012	Huron	E 13
702	Ipswich	C 11
394	Irene, Clay	H 16
530	Iroquois	E 14
162	Isabel	C 7
410	Java	C 10
501	Jefferson	H 16
254	Kadoka	F 6
202	Kennebec	F 10
787	Kimball	F 12
566	Lake Andes	G 13
268	Lake Norden	D 15
862	Lake Preston	E 15
278	Lane, Jerauld	E 12
426	Langford	B 14
208	Lantry	C 7
9,763	Lead	E 2
943	Lemmon	B 5
901	Lennox	G 16
501	Leola	B 12
301	Lesterville	H 14
411	Letcher	F 13
149	Lily	C 14
428	McIntosh	B 7
3,949	Madison	E 15
614	Marion	G 15
453	Mellette	C 13
760	Menno	G 15
207	Midland	E 7
1,940	Milbank	C 16
956	Miller	E 11
166	Missionhill	H 15
7,785	Mitchell	F 13
1,551	Mobridge	C 9
170	Monroe	G 15
552	Montrose	F 15
127	Morristown	B 6
288	Mound City	B 9
541	Mt. Vernon	F 13
352	Murdo	E 8
192	Newark	B 14
272	Newell	D 3
119	New Underwood	E 4
128	Nisland	D 2
282	Northville	C 12
174	Nunda	E 15
163	Oacoma	F 10
100	Oelrichs	G 3
362	Oldham	E 15
163	Olivet	G 14
251	Onida	D 9
162	Ortley	C 15
1,324	Parker	G 15
1,132	Parkston	G 14
301	Peever	B 16
404	Philip	E 6
320	Pierpont	C 14
3,010	Pierre	E 8
916	Plankinton	F 12
939	Platte	G 12
238	Pollock	B 9
355	Presho	F 9
182	Pukwana	F 11
324	Ramona	E 15
4,268	Rapid City	F 3
96	Ravinia	G 13
241	Raymond	D 14
3,122	Redfield	D 13
293	Revillo	D 17
283	Rockham	D 12
320	Roscoe	C 11
154	Rosholt	B 16
150	Roswell	F 14
1,132	Salem	F 15
1,249	Scotland	G 14
646	Selby	C 10
182	Seneca	C 11
211	Sherman	F 16
145	Sinai	E 16
16,499	Sioux Falls	F 16
1,386	Sisseton	B 15
331	South Shore	C 16
171	South Sioux Falls, Minnehaha	F 16
921	Spearfish	D 2
572	Spencer	F 15
695	Springfield	H 14
253	St. Lawrence	E 11
117	Strandburg	C 16
312	Stickney	F 13
1,029	Sturgis	E 3
536	Summit	C 15
441	Tabor	H 14
177	Tea	G 16
491	Terraville	E 2
238	Timber Lake	C 8
148	Tolstoy	C 10
438	Toronto	D 16
274	Trent	F 17
903	Tripp	G 14
263	Turton	C 13
177	Twin Brooks	C 16
1,302	Tyndall	H 14
133	Utica	H 15
372	Valley Springs	F 16
340	Veblen	B 15
89	Verdon	C 13
2,376	Vermillion	H 15
484	Viborg	G 15
458	Vienna	D 14
141	Vilas	F 14
616	Volga	E 16
333	Volin	H 15
906	Wagner	G 13
403	Wakonda	H 16
128	Wall	E 5
218	Wallace	C 15
102	Ward	E 16
8,313	Watertown	D 15
879	Waubay	C 15
1,640	Webster	C 14
350	Wentworth	F 15
526	Wessington	E 12
1,142	Wessington Spgs	E 13
581	White	E 16
504	White Lake	F 12
384	White Rock	B 16
295	Whitewood	E 3
398	Willow Lake	D 14
520	Wilmot	C 16
301	Winfred	E 15
923	Winner	G 10
439	Wolsey	E 12
1,201	Woonsocket	E 13
191	Worthing	G 16
73	Wyandotte, Perkins	C 4
4,771	Yankton	H 15



SOUTH DAKOTA

SCALE

Statute Miles, 33 1 Inch.

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Rand McNally's New 11 x 14 Map of South Dakota.
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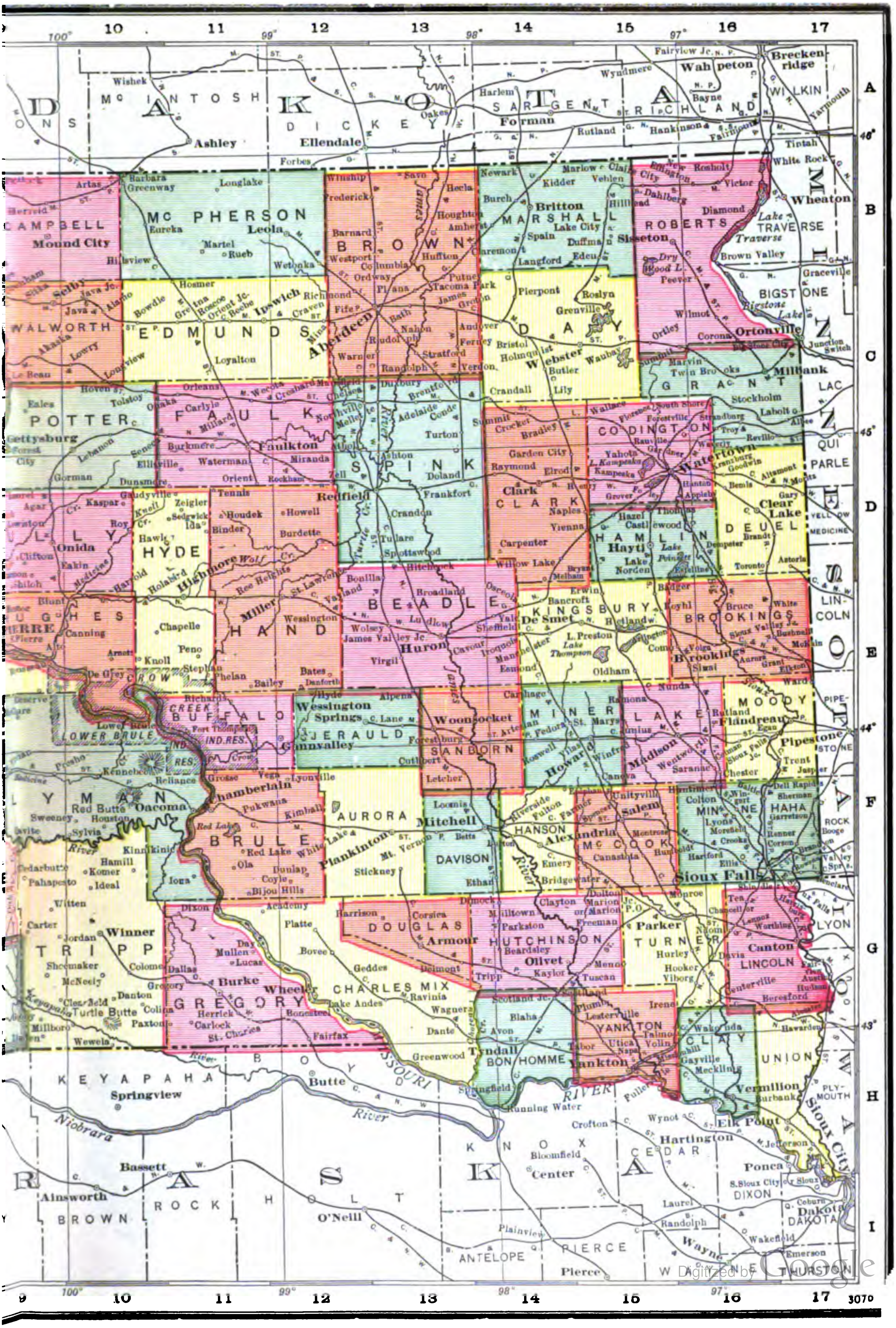
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Hankinson
Fairmount
Wyndmere
Fairview Jc.
Wahpeton
Breckenridge
Tintah
White Rock
Wheaton
Lake Traverse
Brown Valley
Graceville
BIGSTONE
Bigstone Lake
Ortonville
Junction Switch
LAC QUI PARLE
YELLOW MEDICINE
LINCOLN
PIPESTONE
Pipestone
ROCK
LYON
M I N N E S O T A
I O W A
PLYMOUTH
Sioux City
CAMPBELL
Herreid
Artas
Mound City
Pollock
McPHERSON
Eureka
Leola
Longlake
Barbara
Greenway
Martel
Rueb
Wetonka
Hillsview
BROWN
Frederick
Barnard
Westport
Columbia
Hecla
Houghton
Amherst
Hufton
Ordway
Putney
Tacoma Park
Groton
James
Aberdeen
Bath
Nahon
Rudolph
Andover
Ferney
Stratford
Warner
Randolph
Verdon
MARSHALL
Newark
Burch
Britton
Kidder
Marlow
Veblen
Lake City
Spain
Langford
Claremont
Eden
Sisseton
ROBERTS
Rosholt
Victor
Dahlberg
Diamond
New Effington
Claire City
Hillhead
Peever
Dry Wood L.
Wilmot
Ortley
Corona
Summit
WALWORTH
Selby
Java
Akaska
Lowry
Le Beau
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Bowdle
Roscoe
Hosmer
Ipswich
Richmond
Craven
Mina
Loyalton
Longview
DAY
Pierpont
Roslyn
Grenville
Webster
Bristol
Holmquist
Waubay
Butler
Lily
GRANT
Marvin
Twin Brooks
Milbank
Stockholm
Labolt
Albee
Revillo
POTTER
Gettysburg
Forest City
Tolstoy
Lebanon
Gorman
FAULK
Orleans
Carlyle
Millard
Burkmere
Faulkton
Seneca
Ellisville
Waterman
Miranda
Orient
Rockham
Dunsmore
SPINK
Northville
Mellette
Ashton
Redfield
Doland
Turton
Conde
Frankfort
Athol
Zell
Crandon
Tulare
Spottswood
Brentford
Adelaide
Crandall
CLARK
Crocker
Bradley
Garden City
Raymond
Clark
Naples
Vienna
Carpenter
Willow Lake
Elrod
CODINGTON
Wallace
Florence
South Shore
Watertown
Kampeska
Henry
Grover
DEUEL
Clear Lake
Gary
Goodwin
Altamont
Brandt
Toronto
Astoria
Bemis
HAMLIN
Hayti
Castlewood
Hazel
Thomas
Lake Norden
Bryant
Estelline
Dempster
SULLY
Onida
Agar
Clifton
Harrold
HYDE
Highmore
Holabird
Hawley
HAND
Miller
St. Lawrence
Vayland
Wessington
Ree Heights
Bates
BEADLE
Huron
Broadland
Wolsey
Virgil
Hitchcock
Osceola
Yale
Cavour
Iroquois
Bonilla
Ludlow
KINGSBURY
De Smet
Bancroft
Erwin
Badger
Arlington
Lake Preston
Lake Thompson
Oldham
Manchester
Esmond
BROOKINGS
Brookings
Aurora
Elkton
Volga
White
Bushnell
Sinai
HUGHES
Pierre
Blunt
Canning
De Grey
Chapelle
Peno
Knoll
Stephan
Phelan
Bailey
Danforth
Crow Creek
BUFFALO
Fort Thompson
LOWER BRULE
IND. RES.
Gannvalley
Wessington Springs
JERAULD
Lane
Alpena
SANBORN
Woonsocket
Forestburg
Cuthbert
Letcher
Artesian
MINER
Fedora
Howard
Carthage
Canova
Winfred
LAKE
Madison
Rutland
Ramona
Nunda
Wentworth
Chester
MOODY
Flandreau
Egan
Trent
LYMAN
Oacoma
Reliance
Kennebec
Presho
Red Butte
Sweeney
Houston
Sylvia
Kimball
Chamberlain
Pukwana
BRULE
Red Lake
Ola
Iona
Bijou Hills
Dunlap
AURORA
Plankinton
White Lake
Mt. Vernon
Stickney
DAVISON
Mitchell
Loomis
Ethan
HANSON
Alexandria
Fulton
Emery
Bridgewater
Farmer
McCOOK
Salem
Canistota
Montrose
MINNEHAHA
Colton
Dell Rapids
Baltic
Garretson
Sherman
Renner
Brandon
Hartford
Sioux Falls
Valley Springs
TRIPP
Winner
Jordan
Colome
Carter
Witten
Ideal
Hamill
Kinnikinic
Shoemaker
McNeely
Millboro
Wewela
Keyapaha
GREGORY
Burke
Bonesteel
Fairfax
Herrick
Carlock
St. Charles
Dallas
Gregory
Dixon
Mullen
Paxton
Lucas
Wheeler
CHARLES MIX
Platte
Academy
Geddes
Lake Andes
Ravinia
Wagner
Dante
Greenwood
DOUGLAS
Armour
Corsica
Harrison
Delmont
HUTCHINSON
Olivet
Parkston
Milltown
Tripp
Kaylor
Menno
Tuscan
Freeman
Clayton
Dimock
TURNER
Parker
Hurley
Hooker
Viborg
Irene
Marion
Chancellor
Monroe
LINCOLN
Canton
Lennox
Worthing
Davis
Centerville
Beresford
Hudson
Fairview
BON HOMME
Tyndall
Avon
Scotland
Springfield
Tabor
YANKTON
Yankton
Lesterville
Utica
Volin
Gayville
CLAY
Vermillion
Wakonda
UNION
Elk Point
Hawarden
Jefferson
Missouri River
Running Water
Crofton
Wynot
Hartington
CEDAR
Ponca
S. Sioux City
DIXON
Dakota
DAKOTA
KNOX
Bloomfield
Center
Niobrara
KEYAPAHA
Springview
BOYD
Butte
Bassett
Ainsworth
ROCK
BROWN
HOLT
O'Neill
ANTELOPE
PIERCE
Plainview
Pierce
Laurel
Randolph
Wayne
WAYNE
Wakefield
Emerson
THURSTON
N E B R A S K A

part of the State. The moisture comes principally from the Gulf of Mexico and the Atlantic Ocean and is abundant for agricultural purposes over nearly all the cultivated section of the State. The annual rainfall in the eastern half of the State averages little more than 22 inches and in the western half 17 inches. The summer rainfall averages about 15 inches for the entire State during the growing season.

Agriculture.— The chief industry of South Dakota is agriculture, except in the southwestern portion of the State, where there are extensive gold mines and where mining is the only occupation of importance. The broad fertile prairies are fast being converted into rich fields of various food crops. One can drive for miles with waving fields of grain on both sides of the road as far as his eye will carry and of corn also hedging the way with its green cooling foliage to soften and reduce the sun's heat on July and August days. All varieties of small grain are grown successfully over almost the entire State. Corn is grown best in the Southern and Eastern portions. Yet in the Central part its yield is increasing each year.

Soil cultivation is becoming more general the last decade than ever before. Considerable fall wheat is now sown but spring sowing is still the most common practice. Crop rotation too is just receiving attention and will soon become general for this method is advocated from every source of reliable information. Irrigation is practised to some extent, especially in the northwestern part of the State and its advantages are coming to be appreciated more and more each year. The Federal government has constructed a large dam on the Bellefourche River and this irrigates a large district which is rapidly developing into a profitable and happy agricultural community. Alfalfa finds in South Dakota a suitable soil and appropriate climatic conditions for its best production and harvesting. It is grown in large quantities on both sides of the river but its ultimate home is destined to be the western section of the State. Here this crop finds a natural and leading place in all agricultural calculations and has been found the most profitable plant that can be grown. Some farmers in this section of the State have sold $100 worth of alfalfa seed per acre in a single season from their alfalfa fields. The statistics presented in this article show what agriculture means to the State of South Dakota and are worth the consideration of any one desirous of appreciating the opportunities this new State offers settlers and investors.

Agricultural Statistics.

(Information furnished 28 Aug. 1919. Department of History)

1. Agricultural land outside corporate limits, 1918	32,898,946 acres
2. Agricultural land within corporate limits, 1918	151,005 acres
Assessed value of item 1, 1918	$980,049,605
Assessed value of item 2, 1918	7,137,292
Number of farms, shown by 1915 census	101,224
Acres in farms, 1915 census	23,820,436
1. Structures on item 1 above mentioned, 1918	80,792
Value	$43,995,438
2. Structures on item 2 above mentioned, 1918	1,473
Value	$2,087,794

Productions of the State for 1918 and their Value.

		Value
Corn	108,888,000 bu.	$126,310,000
Wheat	71,305,000 bu.	142,610,000
Oats	75,816,000 bu.	42,456,000
Barley	33,099,000 bu.	24,456,000
Rye	4,000,000 bu.	5,000,000
Flaxseed	1,330,000 bu.	4,522,000
Potatoes	7,760,000 bu.	7,011,000
Hay	2,750,000 tons	40,500,000
Vegetables and fruits		10,000,000
Dairy products		12,500,000
Poultry products		12,500,000
Livestock (sold)		124,401,000
Minerals		6,800,000
Pelts, wool and furs		3,500,000
Total value for 1918		$562,495,000

The following table shows what South Dakota sold outside the State for year ending 30 June 1918:

	Value
Corn, 13,050,000 bushels	$15,138,000
Wheat, 27,917,000 bushels	55,834,000
Oats, 32,845,000 bushels	18,433,000
Barley, 20,458,000 bushels	14,938,000
Rye, 3,245,000 bushels	4,478,000
Flax, 682,000 bushels	2,318,000
Horses, 37,860,000 pounds	3,786,000
Cattle, 579,432,000 pounds	56,784,000
Sheep, 21,550,000 pounds	2,047,000
Hogs, 376,737,000 pounds	61,784,000
Other products	35,000,000
Total for 1918	$270,536,000

Stock Raising.— Stock raising from the first settlement of the State has been a prominent feature of agricultural enterprise. The vast reaches of prairie uplands bordering the rivers of the State are ideal pasture lands for both cattle and sheep, also horses range on these lands and are grown in profitable numbers. But cattle have from the early days of territorial times been the favorite animal to produce and market. Many large herds have been developed on prairie grass which grows in enormous quantities fitting cattle for the market without any grain supply whatever. Hogs are in recent years receiving more attention and render excellent returns for the care and feed they require.

Livestock Statistics, 1918.

Horses and mules, one year and under	101,817	$2,861,758
Horses and mules, two to three years	102,776	4,611,143
Horses and mules, over three years	520,397	42,295,713
Stallions and jacks for service	4,462	1,073,362
Cows, all ages	773,039	42,661,077
Cattle, one year and under	652,794	18,439,403
Cattle, two to three years	489,926	21,728,168
Cattle, three years and over	141,890	9,134,632
Sheep, all ages	533,511	5,440,701
Hogs, all ages	738,109	11,952,753

Manufactures.— In 1914, measured by the value of products of its manufacturing industries — $24,138,566 — South Dakota ranked 45th among the 48 States comprising continental United States, holding the same rank in respect to wage-earners, with an average of 3,788 engaged in such industries. In that year there were reported in operation 898 establishments, having an invested capital of $15,059,583 and paying $2,628,152 in wages to 3,788 wage-earners.

The cost of raw materials was $17,079,357; the value of products $24,138,566, leaving the value added by manufacture at $7,059,209. The following table shows the relative importance and strength of the various industries in the State:

INDUSTRY	Number of establishments	Number of wage-earners	Value of products
Flour and grist mills	72	255	$5,556,996
Butter	62	134	2,920,342
Printing and publishing	379	801	2,135,580
Bread and bakery products	88	255	1,256,121
Cars and shop construction	6	579	1,177,759
Lumber and timber	51	281	860,143
Confectionery	4	105	545,710
Tobacco and cigars	40	197	434,028
Gas	17	80	379,543
Liquors, malt	4	71	362,128
Mineral and soda waters	27	63	225,953
Marble and stone work	11	29	174,750
Foundry and machine shops	20	60	169,011
Copper, tin and sheet metal	5	24	162,749
All others	112	854	7,777,753

To this list may be added that of the packing-house industry. There are several of these in the State, the largest of which is located at Sioux Falls where there are more than a thousand persons engaged in that industry, one firm having a pay-roll of over $60,000 per month. At Huron the farmers have erected a big packing-house. Canning factories are also being established in several sections of the State. One of the largest of these is a corn-canning plant just outside the city of Parkston in Hutchinson County. Here there is an enterprise producing canned corn to the extent of 15,000 to 20,000 cans per year, with a promise of larger production in the near future. The plant is operated but a few days each year when corn is prime for such a process, hence it does not give constant employment. It is, however, suggestive of the spirit and enterprise of the people in the State.

Mineral Resources.— These are gold, building stones, silver, clays and lead. Gold is the most valuable of these metals and was first discovered in the Black Hills by a soldier with Custer's troops in 1874. The richest deposits of gold are in Northwestern Hills and there is located one of the largest gold mines in the world. The Homestake at Lead yields half a million per month and is famous for its magnitude and scientific operation. South Dakota has large quantities of excellent building material and these rank second in value. The Dakota sandstone which outcrops about the edge of Black Hills makes handsome and durable building material. At Dell Rapids and Sioux Falls are large deposits of hard pink quartzite which also makes durable and beautiful buildings. *Deposits* of gypsum occur in the hills and quantities of chalk stone are found along the Missouri from Yankton to Chamberlain. This is nearly pure chalk and is suitable for manufacture of Portland cement. Materials for making brick are widely distributed over the State.

Gold produced in 1917 was	$7,412,000 00
Silver produced in 1917 was	193,000 ounces
Finances; The total assessed valuation of all:	
Taxable property in 1918 was	$1,595,544,562 00
Total receipts for State in 1918 were	4,653,190 56
School fund invested in 1918 was	16,077,718 63
Bank deposits 30 Sept. 1918 were	206,496,073 89
Amount expended for public schools 1918 was	7,863,316 00
Total cost of maintaining State government 1918 was	4,001,144 50
Total State debt 20 Nov. 1918 was	332,136 00

Railway Mileage.— South Dakota has 4,832 miles of railway. Of this the Chicago, Milwaukee and Saint Paul and the Chicago and Northwestern own much the largest amount.

Education.—This important subject receives special consideration from the people of the State. When the State was admitted into the Union, Congress set apart the 16th and 36th section of every township for benefit of the public schools of the State. It also, by act of 18 Feb. 1881, specified that none of the Federal lands granted for educational purposes should be sold for less than $10 per acre. This was a wise feature and was incorporated into the South Dakota constitution by those who formulated that important instrument. By observing this Federal requirement the school lands have been conserved until they have become valuable and some have been sold recently for more than $100 per acre. The public school fund of the State has grown to large proportions and was at the close of the fiscal year 1917 $9,268,235.17. The Federal lands granted by Congress to the State for educational, penal and benevolent institutions amounted to 500,000 acres. The different State educational institutions were given donations from this inheritance as they were established by the State legislature. For example, the State University was given 40,000 acres; the State agricultural College 40,000 acres, which with the 120,000 acres given to it direct by Congress, makes its land endowment 160,000 acres. From this source, rent of college land and interest on its endowment fund, the college now receives over $30,000 a year income. The State normals at Madison and Spearfish each received 40,000 acres, and the other State schools as they were established were given a part of the public domain. The public school system is presided over by a State Superintendent of Public Instruction, elected by popular vote, whose department is composed of a staff of educational experts in charge of the various phases of public school activity. One man is supervisor of rural and consolidated schools, another is inspector of high schools, while others carry on the work of teacher examinations and certification. Very radical changes are now being made in the educational system of the State. Consolidation of rural schools is coming fast and means much to the present and future child of the State. School activities no longer consist only in mental gymnastics, but include skill in handwork and training for industrial careers as well as for college and the learned professions.

The following statistics and account of different State educational institutions will enable the reader to estimate somewhat intelligently what kind of education is offered the youth of the State and how the people view educational interests and results. There are

1 The Famous Hopestake Mine, at Lead City

2 The City of Deadwood

seven higher institutions of learning maintained by the people of the State. These are State University, State College of Agriculture and Mechanic Arts, State School of Mines and four normal schools.

The State University is located at Vermillion in the southern portion of the State, at the junction of the Vermillion with the Missouri River. The university has seven buildings; a faculty of 60 members and a student body in 1918 of over 600. The organization includes the College of Arts and Sciences, College of Law, College of Music, College of Medicine and College of Engineering.

The State College of Agriculture and Mechanic Arts is located at Brookings in the eastern part of the State only 17 miles from the Minnesota border. The institution has some well defined lines of work assigned to it as follows: research and special scientific investigation; instruction along special lines; agricultural extension to include farm and home demonstrations. The work of the institution is carried on in the 10 buildings on the college campus and the large college farm connected with the college also at the several sub-stations operated from the college. These are located as follows: Highmore, Eureka, Cottonwood and Vivian. In 1917 there were 620 students enrolled and a faculty of 75 instructors.

The State School of Mines is located at Rapid City in the western part of the State. There are four buildings on this campus and the legislature in 1919 appropriated $100,000 for a fifth one.

The four normal schools are located as follows: Spearfish Normal in northwest section of the State, Lawrence County; Aberdeen Normal in Brown County, north section of the State; Madison Normal in Lake County, the eastern part of the State, and Springfield Normal in Bon Homme County, the southeast section of the State. These four normals and the three higher educational institutions of the State are all under one board of management. This board is made up of five men appointed by the governor and confirmed by the senate. Their term of office is six years.

In addition to these higher educational institutions supported by taxation, there are a number of denominational institutions, which are growing in favor and influence. Among these are the following: Dakota Wesleyan University at Mitchell, maintained by the Methodist Church. This institution had, 1918, 225 students and 25 members in the faculty. Huron College, Huron, is maintained by the Presbyterian Church, and reported 107 students in 1918 with 22 members of the faculty. Yankton College at Yankton is supported by the Congregational Church. It reported 133 students in 1918, with 25 members in the faculty. Sioux Falls College at Sioux Falls is supported by the Baptists. It reported an enrolment of 100 students with 12 members in the faculty. The Catholics of the State support a number of schools; also Notre Dame Academy at Mitchell and Presentation Academy at Aberdeen. The Norwegian Lutherans have a Normal School and College at Sioux Falls and also at Canton.

The following educational statistics may serve to further reveal the educational activity of the people in this new State:

Consolidated schools:	
Enrolment below high school	3,623
Enrolment in high school	782
Independent districts — cities and towns:	
Enrolment below high school	35,046
Enrolment in high school	10,177
Rural districts:	
Enrolment below high school	86,752
Enrolment in high school	2,096
Number of school houses in 1918:	
Consolidated districts	56
Non-accredited high schools	96
Schools not reporting	27
Total	216
Teachers employed, 1919:	
Male	805
Female	6,635
Average monthly salary:	
Male	$102.39
Female	68.50
School expenditures, 1918:	
Rural districts	$4,231,177.22
Independent districts	3,180,765.86
Consolidated districts	451,373.72
Total	$7,863,316.80

The legislative appropriations of 1917, for period of 1917 to 1919, were $1,246,600 general, for higher institutions; $707,570 special, for higher institutions. Out of the two items the Agricultural College received $312,000 from the general fund, and $243,000, special, and the experiment stations received $8,000.

The census of 1915 gives 3,134 illiterates, or .72 per cent of the population.

Penal and Charitable Institutions.— These are the State Penitentiary, located at Sioux Falls; the State Insane Hospital, located at Yankton; the State Reform School, located at Plankinton; the School for the Deaf at Sioux Falls, and the School for the Blind at Gary; also the School for Feeble Minded at Redfield. All these are under the Board of Charities and Corrections, composed of three men appointed by the governor and confirmed by the senate.

Religion.— Religious liberty is fully enjoyed by the people of South Dakota, and is guaranteed to them by a specific section in the State constitution. Nearly all sects and creeds are represented in the religious organizations of the State, and none are prevented from following that form of worship they deem most important and helpful.

War Activities.— The people of South Dakota responded promptly and liberally to every demand made upon her for support of the war.

LIBERTY BONDS PURCHASED.

First loan	$3,923,000 00
Second loan	12,864,000 00
Third loan	31,443,000 00
Fourth loan	35,642,000 00
Fifth loan	20,500,000 00
Total	$104,372,000 00
Red Cross for year ending 11 Dec. 1918	$1,649,593 00
Knitted articles, 784,411 (value)	694,895 10
Refugees garments, 43,606 (value)	59,516 83
Surgical dressings, 1,556,297 (value)	101,310 97
Total	$2,505,315 90
Red Cross membership in South Dakota, 296,275 (contributed)	1,950,737 00

Early History — Exploration, Settlement and Development.— When in 1803 France ceded to the United States her possessions in the Northwest, the Territory of North and South Dakota was an unknown and trackless wilderness inhabited only by wild beasts and savage Indians. A few adventurers such as LeSueur, Trudeau and Loisel had traversed this land to some extent in their traffic with the Indians and in some instances attempted settlement, but these were soon abandoned. All this region was marked on the maps of those days an "unexplored" country. In 1804 Lewis and Clark visited the Territory. Their records show that in August of that year (1804) they camped for three days at Yankton where the Yankton or James River empties into the Missouri. From there they went up the Missouri, exploring that river through the entire Territory of Dakota, then up the Yellowstone and on to the Pacific. The first white settlement of record in the State was made on 11 Nov. 1794 in what is now Charles Mix County, by J. B. Trudeau, but this did not become permanent, neither did the settlement on the Missouri River at Big Bend made in 1797 by Registre Loisel. Fort Pierre was settled in 1817 by Joseph LaFramboise and has remained to this day.

The American Fur Company made incursions into the Territory as early as 1811. In June 1831 a steamboat built by this fur company found its way to Fort Pierre. This was the first steamboat to navigate the upper Missouri and was named the *Yellowstone*. This greatly accelerated fur trading and other commercial relations with the Indians. The *Yellowstone* made another trip up the Missouri through South Dakota in 1832 and this time went as far north as the mouth of the Yellowstone River. Among its passengers on this trip was George Catlin, the famous painter and ethnologist. Mr. Catlin spent some time at Fort Pierre during the summer of 1832, studying the Indian in his primitive life, and again visited the State in 1836, while inspecting the work of the Indians at Pipestone quarry in Western Minnesota. In 1838 Gen. John C. Fremont, the noted pathfinder, explored the eastern portion of the State, taking levels of prominent points and discovering and naming many lakes. The next year (1839) he again visited the State, going by steamboat to Fort Pierre and from there Northeast to Devils Lake, N. D. He was accompanied this time by Joseph N. Nicollet, geographer and astronomer. By 1840 the activity of the American Fur Company had decreased the buffalo herds and fur-bearing animals of the Dakota Territory, and the fur industry was fast losing its importance in this region. Ten or 12 years more, or by 1855, the fur trade of Dakota was about over and the great buffalo herds of the plains had nearly disappeared. Fort Pierre was sold that year by the American Fur Company to the United States government and thereafter became a military post. Between the Fort Pierre settlement in 1817 and that of Sioux Falls in 1858 there seems to have been little attention given to the fertile prairies of this great Territory. The settlement at Sioux Falls in 1856 opened the way for rapid and permanent occupation of the rich bottomlands of the Big Sioux River. The next year (1857) the Minnesota legislature chartered the Dakota Land Company, and from that on settlements were made at various places on the eastern side of the State and along the Missouri River.

A territorial government was provided by Congress in 1861, after a long controversy between citizens of the Territory and Congressional representatives from Minnesota, the latter claiming that Dakota belonged to and was a part of the Minnesota Territory. Indian warfare interfered very seriously with the settlement and development ot this new land for a number of years. By 1862 there were many settlers established along the Missouri and the Sioux rivers. During harvest season that year (1862) the Santee Sioux on the Minnesota River took to the warpath and massacred white settlers wherever they could find them. Near Sioux Falls these blood-thirsty savages attacked and killed Judge Joseph Amidon and his son in the hayfield. This caused terror in the hearts of nearby settlers who left their stock and crop and fled for their lives. At this time the Indians destroyed many homes and large numbers of stock, also grain in abundance just ready for the harvest. Another outbreak occurred in 1865 when much property was again destroyed and some settlers killed. In 1869 a treaty was signed between the Indians of Dakota Plains and the Federal authorities, but this did not last many years. By June 1876 further outbreaks occurred and the government sent a large force of Federal troops under General Custer to quell the outbreak, but this brave general with some 300 of his men, were killed before peace could be arranged with the Indians. This, however, was about the last of Indian warfare and after that date settlers suffered but little from attacks by Indians.

Government.—South Dakota became a State in 1889. The enabling act was the Federal omnibus bill which admitted into the Union North and South Dakota, Montana and Washington. The constitution which was then adopted by the people of South Dakota is regarded as one of the most stable and comprehensive in the United States. As originally adopted it comprised 26 articles which embraced a wide range of subjects pertaining to the rights of citizens and the proper control of State affairs. The usual form of *three* departments, the legislative, executive and judicial, is employed, with the governor authorized to veto such legislation as he may find undesirable. This right, however, is seldom exercised. The legislative power was vested in a senate of 45 members and a house of representatives of 124 members. These may be increased from time to time by legislative enactment. The legislature convenes every two years on the first Tuesday of January and must adjourn at the end of 60 days not including Sundays. Members of the legislature get no salary for their services, but are allowed a per diem of five dollars during time the legislature is in session and mileage to and from their homes. There is a Supreme Court of five judges elected by the people, who hold office for six years, and may and do succeed themselves when re-elected by the people at the general biennial election. There are also district judges elected by the people and county judges to deal with probate business of their locality. The constitution was amended in 1918 to give the ballot to all citizens of the State 21 years of age or over, and to those fully naturalized. This right can be exercised only after residence in the United States five years, of the State one year, the county 90 days, and the election precinct 30 days. Bone dry prohibition is in force in the State and was obtained by an amendment to the State constitution. This constitution provides for exercise of the Initiative and Referendum. Both are used by the people, but chiefly that of referring important laws to the people for their approval or rejection at the time of the general election. The primary election method of selecting officers is in force and a very general interest is shown in that public function. The people of South Dakota are as a whole patriotic and loyal both to State and national interests. This is indicated by their response to calls for service during the World War.

State Capitol.— The State capitol is at Pierre, on the Missouri River, near the geographic centre of the State. The building is completely fireproof. Foundations are of fieldstone, the first story of Raindrop sandstone and the superstructure of Bedford limestone. The interior is of brick and reinforced concrete. Dimensions are 287 feet long, 145 feet wide, 165 feet from ground floor to top of lantern on dome. There are four floors. The interior finish is in marble, oak and birch. Decorations are simple but impressive. There are nine large mural paintings, among which is Blashfield's most important creation. The style, furniture, decorations and finish of the building show excellent taste and artistic good sense.

GOVERNORS OF SOUTH DAKOTA.

Arthur C. Mellette	Republican	1889-93
Charles H. Sheldon	"	1893-97
Andrew E. Lee	Populist	1897-1901
Charles N. Herreid	Republican	1901-05
Samuel H. Elrod	"	1905-07
Coe I. Crawford	"	1907-1909
Robert S. Vessey	"	1909-12
Frank M. Byrne	Republican-Progressive	1913-17
Peter Norbeck	Republican	1917-

Population.— The 1910 census gives the State a population of 583,988. In 1917 it was 716,972. The organized Counties, with population census of 1915, are as follows:

Armstrong	231	Jerauld	5,275
Aurora	6,736	Kingsbury	11,947
Beadle	16,061	Lake	11,865
Bennett	1,488	Lawrence	17,710
Bon Homme	11,560	Lincoln	13,564
Brookings	15,544	Lyman	7,412
Brown	25,969	Marshall	8,391
Brule	6,376	McCook	10,013
Buffalo	1,485	McPherson	6,831
Butte	5,894	Meade	8,724
Campbell	4,888	Mellette	3,427
Charles Mix	14,790	Miner	8,007
Clark	10,670	Minnehaha	37,613
Clay	9,214	Moody	9,686
Coddington	15,192	Pennington	10,040
Corson	3,272	Perkins	7,641
Custer	3,452	Potter	3,648
Davison	13,005	Roberts	15,660
Day	14,235	Sanborn	7,377
Duel	8,529	Shannon	...
Dewey	1,145	Spink	14,977
Douglas	6,639	Stanley	2,251
Edmunds	6,845	Sully	2,004
Fall River	6,027	Todd	.....
Faulk	5,265	Tripp	10,262
Grant	10,474	Turner	14,636
Gregory	11,919	Union	11,436
Haakon	3,553	Walworth	5,919
Hamlin	7,791	Washabaugh	.....
Hand	7,286	Washington	.....
Hanson	6,316	Yankton	14,851
Harding	4,821	Ziebach	.....
Hughes	5,055	Pine Ridge	.....
Hutchinson	13,095	Reservation	6,315
Hyde	2,685	Unorganized	2,403
Jackson	2,077		

Some of the larger cities of the State are the following with their populations as given in the 1915 State census: Sioux Falls, 20,929; Aberdeen, 11,846; Watertown, 8,313; Lead, 8,128; Mitchell, 7,785; Yankton, 4,771; Rapid City, 4,268; Madison, 3,949; Brookings, 3,416; Deadwood, 3,113. Nearly all these cities have increased in population by 20 or 30 per cent since 1915. For example, Sioux Falls claims a population now (1919) of over 25,000; Aberdeen of 15,000, etc.

J. W. Heston,
President of the State Normal School, Madison, S. D.

SOUTH DAKOTA, University of, the State university located at Vermilion. The first territorial legislature of Dakota located the University of Dakota at Vermilion in 1862; nothing further was done toward establishing the institution until 1881, when Congress granted 86,000 acres to Dakota for a university when the Territory should be admitted to the Union as a State; the citizens of Vermilion then erected a building and organized an academic department. This action was ratified by the legislature in 1883, the building accepted as a gift to the Territory and the university incorporated. The first classes were opened in 1883. In 1891 the name was changed to University of South Dakota. The university is composed of the colleges of arts and sciences, law, music, medicine and engineering. The university admits women on equal terms with men. The government is by a board of five regents appointed by the governor and confirmed by the senate for a term of six years. The State geological survey is conducted in connection with the university, as is the State Health Laboratory. The offices and laboratories of the Food and Drug Commission are also located at the university. The income of the university is derived mostly from the Congressional land grant of 86,000 acres of which it now has control, and from State appropriations; tuition fees are small; the income in 1914-15 amounted to $220,000. The library in 1916 contained 32,000 volumes, the students numbered 683 and the faculty 60.

SOUTH DAKOTA AGRICULTURAL COLLEGE, the State school of agriculture and technology, situated at Brookings, S. Dak. It was first opened in 1884, and is under the control of the same board of regents as the University of South Dakota (q.v.). It is coeducational. Courses are offered in animal-husbandry, agronomy, horticulture, veterinary science, dairying, mechanical, electrical and civil engineering, architecture, domestic science, pharmacy and general science; in addition to these technical and scientific courses there is a normal course, a business course and a preparatory department. Military drill is also a part of the curriculum. Formerly two courses in agriculture were offered; now there are several groups under the general heading of agriculture; this course requires work in one language, and includes certain practical studies not before offered, such as stock judging, blacksmithing, horseshoeing, etc. The degree of B.S. is conferred. The college farm and grounds contain 400 acres; in 1901 a new physics and engineering building and a plant breeding building were erected. The income is derived mostly from State appropriations and from the annual Federal appropriation in accordance with the law of 1890. The State agricultural experiment station, which is connected with the college, receives a separate Federal appropriation.

SOUTH DAKOTA STATE SCHOOL OF MINES located at Rapid City near the famous gold mining region of the Black Hills. Established 1885. Offers courses in mining engineering, metallurgical engineering, civil engineering, electrical engineering. Well-equipped laboratories and a library of more then 6,000 volumes, chiefly technical. The institution is under control of the State Regents of Education. Its income is derived almost wholly from State appropriations, the tuition fee being only $12 a year.

SOUTH GEORGIA ISLANDS. See GEORGIA, SOUTH.

SOUTH HADLEY, Mass, town, Hampshire County, on the Connecticut River, and on the Boston and Maine and the New York, New Haven and Hartford railroads, 14 miles north of Springfield. The town includes the two villages of South Hadley and South Hadley Falls. It was first settled in 1726–27, was originally a part of the town of Hadley and was separately incorporated in 1753. The river here has a fall of 40 feet that affords power for manufacturing; the first paper mill was established in 1848; the town now contains paper mills, woolen and cotton mills and saw mills. There is a public library, and a public high school; the town is also the seat of Mount Holyoke College (q.v.). Pop. 4,894.

SOUTH HAVEN, Mich., city in Van Buren County, on Lake Michigan, 52 miles southwest of Grand Rapids, and on the Michigan Central and the Kalamazoo, Lake Shore and Chicago railroads. It has an excellent harbor and is a shipping point for fruit. It is patronized as a summer resort, has a fine beach and other attractions. The surrounding country is largely devoted to fruit raising. Manufactures include lumber, crates, flour, canned goods, pianos and pipe organs. It was settled in 1833 and received its city charter in 1902. Pop. 3,577.

SOUTH HOLLAND. See NETHERLANDS.

SOUTH ISLAND. See NEW ZEALAND.

SOUTH KENSINGTON MUSEUM, an institution in London originated by the Prince Consort in 1852, and under the direction of the Committee of Council of Education. It contains a rare collection of ancient and modern art as applied to manufactures, a gallery of British art, an extensive collection of water-color paintings, a collection of sculpture, reproductions of ancient sculptures, Raphael's cartoons and an art library. Other departments contain collections of substances used for food, and of materials employed in building and construction. The loan department is a special feature in connection with the institution. There is also a national art training school and schools of science and cookery. In 1899 the name became officially the Victoria and Albert Museum. The present buildings were erected in 1899, and completed and opened in 1909. Catalogues of its collections are available.

SOUTH KENSINGTON, National Art Schools of, London, England, connected with the Victoria and Albert, or (colloquially) South Kensington Museum, in Brompton, south of Hyde Park, are under the direction of the Department of Science and Art. Their special purpose is to study the application of art to industry. They have the advantage of admission to the priceless collections of all kinds in the museum, which are carefully arranged for purposes of instruction. See LONDON.

SOUTH KINGSTOWN, R. I., town, Washington County, on the southeastern coast, and on the New York, New Haven and Hartford Railroad. The town of Kingstown was settled and incorporated as early as 1674; it was divided into North Kingstown and South Kingstown in 1723. The colonial assembly met at South Kingstown at various times, and in 1790 the convention called to decide on accepting the United States Constitution met here, but voted to adjourn to Newport. In 1780 South Kingstown was one of the wealthiest towns in the State. The industries include cotton mills and machine shops. Fishing and farming are extensively carried on in the district. Pop. (1910) 5,176.

SOUTH MILLS, Battle of. In the fore part of April, 1862, after the capture of Roanoke Island and Newbern, rumors reached General Burnside at the later place that the Confederates were building iron-clad gunboats at Norfolk, Va., with the intention of running them through the Dismal Swamp Canal and Roanoke River to make a descent upon the Union flotilla in Albemarle and Pamlico sounds. Burnside, in co-operation with Commander Rowan of the navy, organized an expedition to move on South Mills, near Camden, destroy the locks of the canal at that point, and the Currituck Canal by blowing up its banks, thus rendering it impossible for the gunboats to come into the sounds. Another object of the movement was to create the impression that the entire Burnside expedition was moving on Norfolk, less than 40 miles distant. The expedition was put under command of Gen. J. L. Reno, who, with the 21st Massachusetts and 51st Pennsylvania, sailed from Newbern to Roanoke, where on 18 April he was joined by Colonel Hawkins' brigade (9th and 89th New York and 6th New Hampshire) with four guns. In all, Reno had about 3,200 men. The transports, accompanied by gunboats, sailed up the Pasquotank River, and about midnight of the 18th Hawkins' brigade began a landing on the east side some four miles below Elizabeth City, which is on the west side. At 3 A.M. of the 19th Hawkins' brigade had been landed and was ordered forward, Reno remaining to bring up the other two regiments, which had been delayed by the grounding of some of the transports. Hawkins, misled by a guide, had marched by a circuitous route, and was overtaken by Reno, some 12 miles out, and Reno took the advance, Hawkins' fatigued brigade following. After marching about four miles, and when within two miles of South Mills, Reno's advance came under an unexpected fire of artillery and was brought to a halt. Reno pushed his guns into action. Col. A. R. Wright, of the 3d Georgia, 585 strong, some drafted North Carolina militia, a company of local cavalry, in all about 750 men and four guns, had taken position across the road. His artillery commanded the road, was supported by infantry in a deep ditch, along which rails were piled, with open ground in front and a dense wood in rear. Skirmishers covered both flanks, which were in the woods. After an artillery duel of an hour Reno ordered the 51st Pennsylvania and then the 21st Massachusetts through the woods on the right to turn the Confederate left, and Hawkins, having come up, was ordered, with the 9th and 89th New York, to follow the two flanking regiments to the right, the 6th New Hampshire being placed on the left of the road to support the artillery. The 51st Pennsylvania and 21st Massachusetts, reaching the Confederate left, opened fire and about the same time the 9th New York, breaking from the woods, made a gallant charge — Reno says an «unauthorized and unnecessary» one — over the open ground upon the Confederate guns, and being met with a severe fire of canister and musketry, was repulsed, but made a quick rally on the 89th New York, and both went forward to join the 21st Massachusetts, which, with the 51st Pennsylvania, had kept up fire, forcing the Confederates to withdraw their guns and retire a mile, upon support that was coming up. On the left of the road the 6th New Hampshire had made a gradual advance to within 200 yards of the right of the 3d Georgia and, pouring in a volley, hastened its retreat. The fight lasted nearly four hours. At 10 P.M. without accomplishing the principal object of his expedition, Reno marched back to his boats, and the troops returned to their stations on Roanoke Island and Newbern. The Union loss was 13 killed, 101 wounded and 13 missing, an aggregate of 127, of which 75 were lost by the 9th New York. The Confederate loss was six killed, 19 wounded and three missing. Consult 'Official Records' (Vol. IX); The Century Company's 'Battles and Leaders of the Civil War' (Vol. I).

SOUTH MILWAUKEE, Wis., city in Milwaukee County, eight miles from the heart of Milwaukee, on the Chicago and Northwestern Railroad. It has a high school and a public library. Manufactures include steam shovels, dredges and wreckers, stoves, rakes, chains, baskets and woolen shawls. It received its city charter in 1896. Pop. about 6,092.

SOUTH MOUNTAIN, Battles of. When General Lee led the Confederate army across the Potomac into Maryland (5 Sept. 1862), east of the Blue Ridge, he expected that the Union troops holding Winchester, Martinsburg and Harper's Ferry would be withdrawn, thus opening his line of communication through the Shenandoah Valley. Upon his arrival at Frederick, much to his surprise he found that this had not been done; and as an uninterrupted line of communication through the valley was an absolute necessity for his intended campaign into Pennsylvania, prompt measures were taken to secure it. On the morning of the 10th, Jackson with 14 brigades marched from Frederick, passed over South Mountain at Turner's Gap, crossed the Potomac at Williamsport, on the 11th, drove the Union garrison at Martinsburg into Harper's Ferry, and proceeded to invest that place from the Virginia side of the Potomac. McLaws, with 10 brigades, crossed the South Mountain at Brownsville Gap, and seizing Maryland Heights, invested Harper's Ferry from the Maryland side. Walker's division crossed the Potomac at Point of Rocks and seized Loudoun Heights. (See HARPER'S FERRY; MARYLAND CAMPAIGN OF SEPTEMBER 1862). Lee followed Jackson through Turner's Gap; D. H. Hill's division was left at Boonsboro, to support Stuart's cavalry, which was to hold Turner's Gap and watch McClellan; and with the divisions of D. R. Jones and J. B. Hood, and the reserve artillery, all of Longstreet's command, Lee marched to near Hagerstown to await the result of the movement on Harper's Ferry, and the subsequent concentration of his widely dispersed command for the movement into Pennsylvania.

The advance of McClellan's army reached Frederick on the 12th. Before noon next day there was found in the abandoned Confederate camp the order, known as «Order 191,» for the movements of Lee's army for the 10th. The copy was from Lee to D. H. Hill and showed the position of every division of Lee's army, and what it was expected to do, that at the time Jackson, McLaws and Walker were investing Harper's Ferry, and that Lee, with Longstreet and D. H. Hill, was beyond Turner's Gap. It was not later than noon when McClellan had this valuable paper placed in his hands, but he did not act promptly upon it. It was not until 3 P.M. that he ordered Pleasonton, then near Middletown, to ascertain whether the Confederates had moved in the direction indicated in the order. At 3.35 P.M. Cox's division of the Ninth corps was ordered to march from Frederick to Middletown and support Pleasonton's cavalry in a reconnoissance to Turner's Gap. Pleasonton advanced toward Turner's Gap and found his progress checked by Stuart's cavalry. It was late in the day when McClellan had come to the decision to relieve the garrison at Harper's Ferry, and at the same time fall upon and destroy Lee's isolated command at Boonsboro. Franklin's Sixth corps and Couch's division were to move through Crampton's Gap of South Mountain, break the line of investment that McLaws had thrown across Maryland Heights and the foot of Pleasant Valley, thus relieving Miles at Harper's Ferry, and at the same time interpose between McLaws and that part of Lee's army at Boonsboro and Hagerstown. At the same time Burnside, with the First and Ninth corps, supported by the rest of the army, was to move through Turner's Gap and fall upon Lee, who it was thought had Longstreet and D. H. Hill at Boonsboro. It would have been well had these orders been given early in the afternoon of the 13th and the troops immediately put in motion for the passes of the mountain, but it was not so. The orders were to move next morning; meanwhile Pleasonton was to fire occasionally a few artillery shots, even though no enemy appeared in front, so that Colonel Miles, at Harper's Ferry, would know that the Union army was near.

Battle of Crampton's Gap.—General Franklin who was at Buckeystown, six miles from Frederick, and between it and the Potomac, marched at 6 A.M. by way of Jefferson, where he halted an hour for Couch's division to join him from Licksville, but Couch not coming up, he resumed the march and at noon halted two miles short of Burkittsville, which lay half a mile from the foot of Crampton's Gap. The gap was thought to be strongly held and Franklin made elaborate preparations to carry it. In fact the gap was held by two small cavalry regiments, part of Mahone's brigade of infantry and two batteries, in all about 900 men, under Col. T. T. Munford. Semmes' brigade, with five guns, held Brownsville Gap, one mile south of Crampton's and 300 of Semmes' men closely supported Munford's right; so, to meet the attack of Franklin's column of nearly 12,000 men, Munford had 1,200 infantry and dismounted cavalry posted behind stone fences and houses at the east foot of the gap, with eight guns in position on the winding road about half way up the mountain. It was determined that the position should be carried by assault, General Slocum's division advancing on the right of the road leading through the gap to make the assault, supported by two brigades of General Smith's division moving on the left of the road. It was 3 o'clock before Slocum's division had been formed, in two lines, Bartlett's brigade on the right, Newton's in centre and Torbett's New Jersey brigade on the left. The day was well spent when the order was given to advance and the skirmishers pushing forward drew the fire of the Confederates posted behind the stone fences and houses; which, with the fire from the artillery on the mountain side was so severe, that the advance was suspended until artillery could be brought up to silence that of the Confederates and batter down the stone fences. The artillery was slow in coming up, Smith had not advanced on the left, the men were becoming restive under the hot fire being poured upon them and without waiting for the artillery to come up or Smith to close up on the left, the three brigade commanders after a hurried consultation and without orders from corps or division commander, ordered a charge, which was gallantly made. The fire poured upon the line was severe and some of the regiments were momentarily shaken, but the stone fences were carried and the Confederates driven up the steep hill, the Union line, much broken, closely following. When nearing the crest of the hill, Cobb's Georgia brigade, which had just come up to support Munford, was encountered in the gap, instantly routed, most of it captured and the Union troops pursued the retreating Confederates to the west foot of South Mountain, when darkness halted them. The Union loss was 113 killed, 418 wounded and 2 missing. The Confederate loss was 70 killed, 289 wounded and 603 captured or missing. In addition they lost four colors, one gun and 700 small arms.

Battle of Turner's Gap.— While Franklin was forcing Crampton's Gap, Burnside, with the First and Ninth corps was severely engaged at Turner's Gap, six miles northeast of Crampton's. The engagement was most severe at and south of Fox's Gap, a mile or more south of Turner's, and there was a fierce contest north, but as both was for the possession of the main road, which ran through Turner's Gap, this has given the Union name to the battle — the Confederates call it the battle of Boonsboro. On the night of the 13th Pleasonton, failing to get infantry support, bivouacked in the valley, near the foot of Turner's Gap, and early in the morning pressed his reconnaissance and soon ascertained that the Confederates were in some force in the Gap. Two batteries of artillery were brought up, and opened fire upon Confederate artillery well up in the Gap; and Cox, whose division had bivouacked near Middletown, advanced a short distance on the main road, and then with two brigades marched to the left on the old Sharpsburg road to reach the flank of the Confederate position. As he approached Fox's Gap, one mile south of Turner's, he received artillery fire. D. H. Hill, whose five brigades had been halted near Boonsboro, three miles west of Turner's Gap, when informed by Stuart that Pleasonton was advancing, on the 13th sent two brigades and two batteries back to assist Stuart in checking him. At midnight he received an order from Lee to go in person next morning and assist Stuart. When Hill arrived at the gap before sunrise Stuart had gone to Crampton's Gap and Maryland Heights, leaving Garland's and Colquitt's brigades of Hill's command to defend the gap. It was not long before Hill became aware that Cox was marching on the road to Fox's Gap, held by Colonel Rosser with a regiment of cavalry and two guns. Garland's brigade was sent to Fox's Gap, Colquitt's retained at Turner's, and Anderson's ordered up from Boonsboro. Garland has not been long in position before Cox appeared and attacked him; and after a severe fight, in which Garland was killed and Lieut.-Col. R. B. Hayes of the 23d Ohio wounded, Garland's brigade was routed, and Cox gained the crest of the mountain, just south of Fox's Gap, but could not seize the gap, for at the moment of his victory G. B. Anderson's brigade came up and formed in front and on his right, covering the road through the gap. Learning from prisoners taken that D. H. Hill, with five brigades, was in his front, and that Lee was hastening from Hagerstown, with Longstreet's command, Cox withdrew his advance parties from the woods into which they had charged, and forming line just under the crest of the ridge, awaited reinforcements. The first reinforcement was Willcox's division, which came at 2 P. M. and, forming on Cox's right covered the road through Fox's Gap. Meanwhile other Confederate troops had come up and were coming up to form in Cox's front. Hill had called Ripley's and Rodes' brigades from Boonsboro, and thrown Ripley in front of Cox, and Rhodes to a hill north of Turner's Gap. General Lee, leaving Toombs' brigade near Hagerstown, marched back from there with the brigades of G. T. Anderson, Drayton, Kemper, Garnett, Jenkins, Evans and two brigades of Hood's division. After a hot and dusty march of 13 miles, Anderson and Drayton, first arriving, reached the field at 3 P. M., and were sent to support Hill's troops at Fox's Gap, and Drayton, on the left of the line thus formed, advancing from the woods at the gap, was encountered by Willcox, defeated and driven from the field with great loss, more than half of his brigade being killed, wounded and captured. Heavy skirmishing followed all along the line, Sturgis's division came up and partly relieved Willcox, and near sunset General Reno came up, with Rodman's division, one of whose brigades, with a battery, was sent to

Cox's extreme left, the other held on the right. Reno rode forward to reconnoiter just to the right of the gap, as Hood's division came up on the Confederate left; there was a scattering fire on both sides; and Reno, commanding the Ninth corps, was killed. At about the same time the right of the Confederate line charged upon the left of Cox's line, held by Fairchild's brigade and Clark's battery, and their quick repulse ended the engagement at Fox's Gap, with the Confederates still holding the gap. The loss of the Ninth corps in this engagement, which continued from 9 A. M. until after sunset, was 157 killed, 691 wounded and 41 missing. The Confederate loss in Cox's front was about 600 killed and wounded and as many more captured.

During the latter part of Cox's engagement at Fox's Gap, General Hooker became severely engaged north of and at Turner's Gap. At daybreak of the 14th Hooker led the First corps from the Monocacy through Frederick and Middletown to Catoctin Creek, where he halted at 1 P. M. for rest and coffee. Under instructions to attack the heights north of Turner's Gap and create a diversion in favor of Cox, he marched by the National road leading over Turner's Gap, turned to the right at Bolivar and marching nearly two miles halted and formed line at the eastern base of South Mountain, about 3.30 P.M.; Meade's division on the right, Hatch's on the left, with Rickett's in reserve. Gibbon's brigade of Hatch's division was left on the National road to advance directly into the gap. In Hooker's front the slopes to the crest of the mountain were very precipitous, rugged and partly wooded, bisected by gorges and small ravines, all presenting difficult ascent to an infantry force, even in the absence of a foe in front. At the time there was a veteran foe in front, well protected by rocks and trees and the numerous stone fences separating the fields. The position to be assaulted was held by the brigades of Rodes, Kemper, Garnett, Evans and Jenkins, all under command of Longstreet. Hooker was very deliberate in his preparations, and it was after 4 P. M. when his line moved forward. Hatch, on the left, made a laborious ascent of the mountain, with frequent halts to draw breath and reform his line; but driving in the Confederate skirmishers, he reached the wooded summit, and after severe fighting, in which he was wounded, succeeded in dislodging the Confederates from the stone fences behind which they had fought, and driving them back to another line. In this he had the assistance of a part of Rickett's division. On Hatch's left Gibbon advanced on the road to the gap, and when near it was checked, after a very stubborn fight, by Colquitt's brigade. It was dark when Hatch and Gibbon ceased fighting, both close up to the gap. On the right Meade's route lay over very broken ground, but crossing ravines, ascending steep hills and charging stone fences, he drove Rodes' brigade and its support from point to point, as it extended to the left, and finally turning it, swept to the left and reached the highest point of the mountain, commanding the summit of the gap, the road through it and the narrow open space around the Mountain House, on which Lee's defeated men were crowded in some disorder. It was dark when this position had been gained and Hooker rested. He had lost 167 killed, 712 wounded and 44 missing. The total Union loss for the possession of Turner's Gap, including Fox's Gap, was 325 killed, 1,403 wounded and 85 missing; the Confederate loss, 248 killed, 1,013 wounded and 662 missing.

The result of the battle was that Lee abandoned his intended invasion of Pennsylvania and ordered an immediate retreat to Virginia. At 8 P. M. he ordered McLaws to abandon his position during the night and recross the Potomac near Shepherdstown Ford, leaving that ford for Longstreet's and Hill's commands, and about the same hour sent a dispatch to Jackson to march up the Virginia side of the Potomac to Shepherdstown Ford, to protect his crossing. These orders to McLaws and Jackson contemplated the abandonment of operations against Harper's Ferry. The trains, reserve artillery and reserve ammunition train, at Hagerstown, were ordered to cross the Potomac at Williamsport, and Toomb's brigade was ordered to march from Hagerstown to Sharpsburg. Between 10 and 11 P.M. Lee's army began its retreat from South Mountain by way of Boonsboro and Sharpsburg, D. H. Hill leading, with orders to cross the Potomac. While on the march Lee heard that Franklin had carried Crampton's Gap, thus shutting up McLaws in Pleasant Valley, upon which he ordered his column to halt at Keedysville to assist McLaws, who was now ordered to cross Elk Ridge, if possible, and join him at Keedysville or Sharpsburg, or to cross the Potomac at Weverton, below Harper's Ferry. Arriving at Keedysville, he could hear nothing of McLaws, and at daylight, 15 September, resumed his march for Sharpsburg, still hoping that McLaws could elude Franklin by crossing Elk Ridge. Before reaching Sharpsburg he heard that Harper's Ferry had fallen, and when across the Antietam he received a dispatch from Jackson stating that he would join him at Sharpsburg, upon which he concluded to give McClellan battle at that place, and immediately made dispositions to contest McClellan's passage of the Antietam, until Jackson, Walker, McLaws and Anderson could join him, by marching up the Virginia side of the Potomac. Consult 'Official Records' (Vols. XIX, LI); 'McClellan's Own Story'; Palfrey, 'The Antietam and Fredericksburg' (New York 1881); Allan, 'History of the Army of Northern Virginia in 1862' (New York 1867); The Century Company's 'Battles and Leaders of the Civil War' (Vol. II).

E. A. CARMAN.

SOUTH NORWALK. See NORWALK.

SOUTH OMAHA, Neb., formerly a city in Douglas County, on the Missouri River, and on the Chicago, Burlington and Quincy, the Chicago, Rock Island and Pacific, the Missouri Pacific, the Union Pacific and other railroads. It has steamer connection with many of the cities and towns on the Missouri, thus adding to its shipping facilities, especially the opportunities for cheap freight transportation. It was chartered as a city in 1885 and incorporated in the city of Omaha in 1915. Pop. about 27,000 at time of its incorporation with Omaha (q.v.).

SOUTH ORANGE, N. J., village in Essex County, on the Rahway River and on the Delaware, Lackawanna and Western Railroad, five miles west of Newark and 15 miles west of New York. It was first settled in 1680 and was a part of the town of Newark until 1806, when the town of South Orange was separately incorporated. It is picturesquely situated among the Orange mountains and has many fine residences, being a favorite place of residence for New York business men. Though largely a residential village, it has manufactures of hats and gelatin. It contains a handsome town hall (completed 1895), a public library, a public high school and a Roman Catholic parish school. It is also the seat of two private schools for girls and of Seton Hall College (q.v.), a Roman Catholic institution. Pop. about 6,500.

SOUTH PASADENA, Cal., city in Los Angeles County, on the northeastern outskirts of Los Angeles, and on the Atchison, Topeka and Santa Fé Coast Line, the Salt Lake Route and the Southern Pacific railroads. The surrounding district is engaged in fruit raising and ostrich farming. Pop. 4,649.

SOUTH POLAR EXPLORATIONS. See Polar Research.

SOUTH PORTLAND, Me., city in Cumberland County, on Fore River, opposite Portland, with which it is connected by four bridges and by ferry. It is a residential city and has a considerable business as a summer resort. Forts Preble and Williams are located here, each being garrisoned by two companies of coast artillery. The Maine School for Boys is situated here. Industries include boat building, flour mills, oil and lead works and railroad machine shops. Pop. 7,500.

SOUTH RIVER, N. J., borough in Middlesex County, on the South River, 25 miles southwest of New York, on the Raritan Railroad. There are extensive deposits of clay and molding sands in the vicinity and manufactures include bricks, fire-proofing materials, handkerchiefs, shirts and embroidery. Pop. 4,772.

SOUTH SAINT PAUL, Minn., city in Dakota County, on the west bank of the Mississippi River and on the southern outskirts of Saint Paul, on the Chicago, Great Western and the Chicago, Rock Island and Pacific railroads. It is an important livestock market, has extensive stockyards and a large packing industry. Manufactures include malt, plaster and cement, and there are tanneries, carshops and a foundry. Pop. 4,510.

SOUTH SEA. See Pacific Ocean.

SOUTH SEA COMPANY, The, a joint-stock company, which, in consideration of certain exclusive privileges of trading to the South Seas, offered the English government easier terms for the advance or negotiation of loans than could be obtained from the general public. In 1720 the proposal of the company to take over the entire national debt (at this time about $17,500,000) in consideration of receiving annually 5 per cent, was accepted and the company promised on return for this privilege (as it was regarded) a premium in their own stock of $35,000,000. Professing to possess extensive sources of revenue the directors held out promises to the public of paying as much as 60 per cent on their shares. It became soon apparent that such magnificent promises could never be fulfilled and in a few months' time the collapse came which ruined thousands. Several important cabinet officers were implicated in the fraud. About one-third of the original capital was saved, which was divided among the stockholders. Sir Robert Walpole was one of the chief opposers of the scheme. Consult Coxe, W., 'Memoirs of Sir Robert Walpole' (London 1802).

SOUTH SEAS. See Pacific Ocean; Polynesia; Melanesia; Micronesia.

SOUTH SHETLAND ISLANDS, Antarctic Ocean, a group of islands situated between lat. 61° and 63° 20′ S., and between long. 54° and 63° W., off the north coast of Graham Land and 600 miles southeast of Cape Horn. The group consists of 12 larger and numerous smaller islands, which are rocky and mountainous. They were discovered by the Dutch navigator Dirk Gerrits in 1599. In 1908 they became a British possession. The seal fisheries are extensive.

SOUTH-WEST AFRICA PROTECTORATE, the territory known before the European War as German South-West Africa. Its official designation became "The Protectorate of South-West Africa in Military Occupation of the Union Forces," so named after its conquest by South African forces under General Botha on 15 July 1915. The territory was placed under the administration of the Union of South Africa by the Peace Treaty of May 1919. It includes the region lying between Angola (Portuguese West Africa) and Cape Colony and extending eastward to Bechuanaland. It is composed of Ovambo, Damaraland and Great Namaqualand; area, 322,450 square miles; pop. before the war, whites, 14,830, of whom 12,292 were Germans. The natives number about 250,000. The military force, including police, was 3,000 men. The region forms a rough triangular mass, with truncated apex resting on the Orange River and broadening northward; total length, 930 miles, and a mean breadth of 400 miles. Long regarded as an arid sandy waste, it was suddenly proclaimed a German possession in 1884 under the title of Lüderitzland. The claim was recognized — after some diplomatic negotiations — and the boundaries were fixed by two conventions with Great Britain in 1884 and 1890, and one with Portugal in 1886. The enclave of Walfish Bay (q.v.) had been annexed by England in 1878 and joined to Cape Colony in 1884. The only other harbors are Ogden, 180 miles off Cape Frio, Sandwich Haven, or Porto do Ilheo, and Angra Pequeña Bay; in addition, the Germans constructed a new harbor at Swakopmund. The Namil Desert separates the sea from the inland districts, where farming is carried on. Water is scarce in the country, what rainfall there is being greatest in the north and east, diminishing toward the south and west, though boring is usually attended with good results. At Tsumeb and other places in the hinterland of Swakopmund copper mining is successfully carried on, while up and down the desert near Angra Pequeña diamond mines are worked. The first diamond was discovered in 1908; since then $37,000,000 worth of diamonds have been extracted. Neither gold nor coal has yet been found. Windhoek is the capital, via which a railroad connects Swakopmund and Angra Pequeña, while another line runs from Windhoek to Tsumeb. The total length of railways in operation in 1913 was 1,305 miles. The Deutsche Kolonial Gesellschaft für Südwest Afrika held a concession of the coast lands. (See War, European, Colonial Campaigns; Beyers, Christian Frederick). Consult Calvert, A. F., 'The German African Empire' (London 1916), and 'South-West Africa During the German Occupation' (London 1915); Frobenius, L., 'The Voice of Africa' (London 1913); Hassert, K., 'Deutschlands Kolonien' (Leipzig 1910); Johnston, Sir H., 'The Colonization of Africa' (Cambridge 1899); Keltie, J. S., 'The Partition of Africa' (London 1895); Koschitzky, M. V., 'Deutsche Kolonialgeschichte' (Berlin 1888); Lewin, E., 'The Germans and Africa' (London 1915); Schulze, L., 'Südwestafrika' (Berlin 1910); Zimmermann, A., 'Geschichte der Deutschen Kolonialpolitik' (Berlin 1914).

SOUTHAMPTON, south-ămp'tŏn or sŭth-hămp'ton, England, an important seaport town, county and Parliamentary borough in Hampshire, 71 miles southwest of London, on the innermost angle of the Southampton-Water. Other streams almost surround the town, which occupies an acclivity and consists of two distinct parts. The walls of the older part, belonging to the Middle Ages, traverse the centre of the town and divide it from the modern portion. The gates of this ancient wall are quite remarkable; Bargate is embattled and machiolated and contains in its upper part the Guild Hall. Saint Michael's is an old Norman church with some fine stained glass and delicate traceries and a lofty tower. *Domus Dei* is an ancient hospital of the 12th century, whose chapel was for some time used by French Protestant refugees. The Royal Victoria Hospital is about six miles from the town at Netley near the ruins of a celebrated abbey. It was founded by Queen Victoria for soldiers of the foreign service, as well as those nearer home, at a cost of $1,750,000. A medical school is attached to it, for the preparation of surgeons for the army medical staff; it is also headquarters for women army-nurses who are trained here for their profession. Other buildings are Holyrood and Saint Mary's churches, the town-hall, custom-house, Watts Memorial Hall, Philharmonic Hall, assembly-rooms, ordnance survey offices, baths, etc. Literary institutions include the free library and grammar school (1550); Trade School; Hartley College, founded for the advancement of the natural sciences, archæology, classical and Oriental literature and connected with the schools of Art and Science at South Kensington; Polytechnicum, Athenæum and theatres. The docks are extensive (250 acres) and the harbor one of the finest in the world. The Prince of Wales' dock is the largest single dock extant. There are carriage manufactories, machine works, breweries and distilleries, ship-building and a cattle market. The trade of the port is enormous. The imports are corn, meat, cheese, fruit, coffee, sugar, cattle, wool, hides and wood. The exports are cotton manufactures, leather, hats, hardware, books and clothes. There are fine parks in the town and Southampton Common, nearby, is a large tract which contains the race-track. Southampton was founded by the Saxons and preserves much of its antique character. Pop. about 120,000.

SOUTHAMPTON, N. Y., village in Suffolk County, on the south shore of Long Island and on the Atlantic Ocean, 85 miles northeast of New York and on the Long Island Railroad. Its principal occupation is that of a summer resort. It has excellent fishing and bathing and many beautiful homes. There is a high school and the Rogers Memorial Library. Pop. 2,509.

SOUTHAMPTON INSURRECTION. See Turner, Nat.

SOUTHARD, sŭth'ard, **Samuel Lewis,** American statesman: b. Baskingridge, N. J., 9 June 1787; d. Fredericksburg, Va., 26 June 1842. He was graduated from the College of New Jersey in 1804 and was afterward admitted to the bar of Virginia. In 1815 he was appointed associate justice of the Supreme Court of New Jersey in which capacity he served until 1821, when he was elected to the United States Senate. In 1823 he was made Secretary of the Navy and in 1829 held the same office in the cabinet of John Quincy Adams. He was appointed attorney-general of New Jersey in 1829 and was elected attorney-general of New Jersey and governor of that State in 1832. He was a member of the United States Senate, 1833–42. His publications include 'Reports of the Supreme Court of New Jersey, 1816–20' (1820); 'Centennial Address' (1832) and 'Discourse on William Wirt' (1834).

SOUTHBRIDGE, Mass., town in Worcester County, on the Quinnebaugh River and on the East Thompson branch of the New York, New Haven and Hartford Railroad; about 71 miles southwest of Boston and 21 miles south by west of the city of Worcester. It was settled about 1730 by people from Medfield and included Sturbridge, Charlton and Dudly until 1801. It was incorporated as a poll-parish 28 Feb. 1801, as a town in 1816. The chief manufacturing establishments are optical works, shuttle works, woolen and cotton mills, knife works and printing works. The town is an industrial and commercial centre of great importance. The principal public buildings are the town-hall, public library, the Y. M. C. A. building, the churches and schools. There are seven churches, a high school, public and parish schools and a fine public library. The government is administered by annual town meetings. The French Canadian element predominates. Pop. 14,200.

SOUTHCOTT, Joanna, English fanatic: b. Gittisham, Devonshire, April 1750; d. London, 27 Dec. 1814. For many years she was in domestic service, attending the Established Church, but also going to Wesleyan meetings. In 1791 she joined the Methodists, but in 1792 left them and began to write prophecies in a combination of doggerel verse and incoherent prose. Converts followed the publication of her tract, 'The Strange Effects of Faith' (1801); the elect were to number 144,000 and their certificates for the millennium were drawn up. Joanna professed to interpret dreams and many absurdities and delusions attended her proceedings until her death by a brain disease. Her followers split into two minor sects, led respectively by John Ward and John Wroe. Consult Aikin (Pugh), 'Memoirs of Religious

Impostors' (1821); Mathias, 'The Case of Joanna Southcott.'

SOUTHCOTTIANS. See Southcott, Joanna; Religious Sects.

SOUTHDOWN, a breed of sheep (q.v.).

SOUTHEND, or SOUTHEND-ON-SEA, England, in Essex County, on the Thames, 42 miles east of London. The public buildings are the theatre, church and hall, technical schools and an isolation hospital. The marine park contains 26 acres, a revolving tower, pavilions, promenade piers and pleasure grounds. Westend is an attractive suburb, with many pretty villas. Southend is the chief station of the coast survey and is above all a much-frequented watering-place — the one nearest London. Its popularity began with a visit by Queen Caroline in 1804. The bathing is excellent. It has a fine pier and esplanade and a lighthouse. German warships bombarded Southend in 1915. Pop. about 60,000.

SOUTHERLAND, William Henry Hudson, American naval officer: b. New York, 10 July 1852. He was graduated at the United States Naval Academy in 1872. As a boy he served as a naval apprentice. He was commander of the *Eagle* in the Spanish-American War in 1898, serving on the Cuban coast. He was promoted through the various grades to the rank of rear-admiral 4 May 1910. He commanded the second division of the Pacific fleet in 1911–12; was commander-in-chief of the Pacific fleet in 1912–13; commanded an expeditionary landing force in Nicaragua in August–October 1912 and in 1913–14 he was a member of the General Board. He was retired upon reaching the age limit in 1914.

SOUTHERN BAPTIST THEOLOGICAL SEMINARY, located at Louisville, Ky. It was established by the Southern Baptists to provide an institution expressly for theological training and was opened in 1859 at Greenville, S. C. During the Civil War it was closed and reopened in 1865 under serious financial difficulties. In 1877 it was removed to Louisville, but the financial resources were precarious until 1880 when a large donation was received and the success of the institution assured. The course of instruction is divided into the following 10 schools: (1) Biblical introduction; (2) Old Testament interpretation; (3) New Testament interpretation; (4) systematic theology; (5) comparative religion and missions; (6) homiletics and elocution; (7) church history; (8) ethics and sociology; (9) pastoral theology; (10) Sunday school pedagogy. Of these schools, four have two departments; the school of Old Testament interpretation includes an English and a Hebrew department, the school of New Testament interpretation an English and a Greek department, the school of systematic theology a general course and a department of Biblical theology, the school of church history, junior and senior departments, the Hebrew, Greek, Biblical theology and senior church history courses are intended for students who have had a higher education, some preparation in Greek being necessary for the Greek course. There are also special courses for advanced work in each department. The degrees conferred: Th.G. (graduate in theology), Th.B. (bachelor in theology), Th.M. (master in theology) and Th.D. (doctor in theology), the last for post-graduate work after the acquirement of the degree of Th.M. The buildings include New York Hall (a dormitory), Norton Hall, the Memorial Library Building and the gymnasium. The library in 1916 contained 25,000 volumes, the students numbered 341 and the faculty 11.

SOUTHERN BAPTISTS, the southern branch of the Baptist Church in the United States, which separated from the main body in May 1845 because of the difficulty of harmonizing the different sections on the slavery question. It is governed by the Southern Baptist Convention and has both Home and Foreign Mission boards, and Sunday school Boards, as well as many young people's societies. The Foreign Missions Board expends about $300,000 annually, and has about 12,000 native members in Italy, Argentina, Brazil, Mexico, Africa, China and Japan. The Home Missions Board includes within its field Cuba and the insular possessions of the United States. It expends about $200,000 annually. On 1 Jan. 1917 there were 23,692 church organizations; 2,711,591 members; and 15,946 ministers. The Sunday schools numbered 18,438, with 159,733 teachers and 1,656,324 pupils.

SOUTHERN BOUNDARY. See Boundaries of the United States.

SOUTHERN CALIFORNIA, University of, a co-educational institution for higher learning opened at Los Angeles in 1880. It has colleges of liberal arts, law, medicine, dentistry, theology, pharmacy, oratory, music and fine arts; and there is also a preparatory school and a Marine Biological Laboratory at Venice, on the Pacific Ocean, 16 miles distant. Its trustees are elected by the Southern California Conference of the Methodist Episcopal Church, but no religious qualifications are required of either students or faculty. The university is situated about three and one-half miles from the heart of Los Angeles. Its grounds and buildings are valued at $600,000, and its library has 26,000 volumes. It had in 1918 4,427 students enrolled, 600 with the colors, and 313 instructors.

SOUTHERN COLLEGE, Birmingham, the chief educational institution of the Methodist Episcopal Church in the State of Alabama resulting from the union, in 1918, of the Southern University, situated at Greensboro, Ala., and Birmingham College, situated at Birmingham, Ala. Birmingham being the greater centre of population and possessing better transportation facilities, the whole college interests, except the high school at Greensboro, were centred in the former place. The Southern University was opened in 1859; but it had a difficult time during the Civil War and the reconstruction period. The State of Alabama was divided into two conferences of the Methodist Church in 1883; but both sections still continued to support the university. However, in 1896, the North Alabama Conference decided to establish a college for men. The new institution was opened in Birmingham in 1897, upon which the northern conference surrendered its interest in Southern University. On the union of Birmingham College and Southern University in 1918, the name of Birmingham Southern College was adopted for the new institution. The college possesses a fine large administration building of brick containing a chapel, society halls, offices and recitation-rooms; three buildings for dormitories; a gymnasium; a residence for the president of the college, and a large modern science hall which houses the library, laboratories, storage vault and possesses numerous classrooms. The scheme of the Birmingham Southern College, as formed in 1918, contemplates ultimately erecting in all 23 buildings arranged according to a landscape scheme around a large campus on the highest elevation of the college grounds which consist of 63 acres, 40 of which are included in the campus. In addition to this Birmingham property the college also owns all the buildings and grounds of the defunct Southern University at Greensborough, together with the endowments belonging to the latter institution. Birmiugham Southern College is administered by a board of trustees consisting of 24 members; and it has an annual endowment of $20,000 from the two church conferences of the State; a productive endowment of $75,000 and a second endowment of $125,000. The college courses lead to two degrees, bachelor of arts and bachelor of science, and the M.A. degree is also conferred.

SOUTHERN CROSS, *in astronomy,* a constellation of the southern hemisphere, composed of four stars, one of which is of the first and two of the second magnitude. They form a figure not unlike a cross, especially when seen above the pole, and are the best-known of the southern constellations.

SOUTHERN MINNESOTA, University of, a co-educationl institution giving normal and business courses, established at Austin by William W. Meiners in 1897. Its president in 1918 was W. W. Meiners, Ph.D., LL.D.

SOUTHERN PACIFIC COMPANY. History.— The late Collis P. Huntington and his associates, who had built the Central Pacific Railroad, the Pacific end of the first transcontinental line, and the Southern Pacific Railroad lines in California, Arizona and New Mexico, and who had secured control of certain railways in Texas and Louisiana, extending from El Paso, Tex., to New Orleans, La., conceived the idea of forming the Southern Pacific Company in order to ensure perpetuity and harmony in the operation of the respective properties as parts of one through line. The Southern Pacific Company was created by a special act of the legislature of the State of Kentucky, approved 17 March 1884. Its charter, which was very broad, authorized it, among other things, to acquire, by purchase or otherwise, stocks, bonds or securities of any company, corporation or association, to construct, acquire, own, lease, maintain or operate railways, steamship lines, telegraph or any public or private improvements; and to buy, hold, sell and deal in all kinds of public and private stocks, bonds and securities. This was the first security-holding company organized to carry on extensive work. The organization of the company took place in August 1884, and active operations began on 1 March 1885 when the lease known as the «Omnibus Lease,» went into effect. Under this lease, which included the lines forming nearly all of the «Sunset Route» from San Francisco to New Orleans by rail and thence to New York by steamer, together with their lateral lines and branches, the Southern Pacific Company operated all the properties as one line, received all revenues and paid all expenses, including rents, taxes and interest, and divided the remaining profits, if any, between the parties to the lease on certain agreed percentages. This lease was terminated as to the lines in the State of Texas, in accordance with a statute of that State on 1 July 1889, and was terminated as to the remaining lines on 31 Dec. 1901. Since the termination of the Omnibus Lease the lines in Texas and Louisiana have been operated by their own organizations, but the Southern Pacific Company has continued to operate the Pacific system lines (which include Central Pacific Railway, Oregon and California Railroad, Southern Pacific Railroad, Southern Pacific Coast Railway) under long-term leases. All of such lines, however, together with the ocean-steamship lines plying between New York, New Orleans, Galveston and Havana, have been dealt with as parts of the Southern Pacific «transportation system.»

Following its incorporation the Southern Pacific Company proceeded to acquire the capital stocks of the companies owning the lines which formed its transportation system and on 31 Dec. 1917 owned all but $81,700 of the $349,082,400 of outstanding capital stocks of the companies mentioned in this article under *Mileage and Service.*

Mileage and Service.— The Southern Pacific system operates in the States of Louisiana, Texas, New Mexico, Arizona, California, Oregon, Nevada and Utah. Its transportation system, which extends from New York City, via New Orleans, La., and Galveston, Tex., to San Francisco, Cal., and Portland, Ore., with a line extending from San Francisco, Cal., to Ogden, Utah, was made up, as of 31 Dec. 1917, as follows:

	Miles of railway	Miles of water lines
Lines operated by Southern Pacific Company under long term leases:		
Central Pacific Railway	2,267	125
Oregon and California Railroad	1,214	....
Southern Pacific Railroad	3,530	....
Southern Pacific Coast Railway	107	....
Lines operated by owning companies:		
Morgan's Louisiana and Texas Railroad and Steamship Company	401	....
Louisiana Western Railroad	208	....
Lake Charles and Northern Railroad	73	....
Texas and New Orleans Railroad	468	....
Galveston, Harrisburg and San Antonio Railway	1,361	....
Houston, East and West Texas Railway	191	....
Houston and Shreveport Railroad	41	....
Houston and Texas Central Railroad	948	....
Arizona Eastern Railroad	378	....
Iberia and Vermilion Railroad	21	....
Southern Pacific Company's Steamship Lines	......	4,400
Southern Pacific Terminal Company (Dock and wharf facilities at Galveston, Tex.)	......	....
	11,208	4,525
Less operated jointly by two or more companies	43	....
Total	11,165	4,525

The service of the company includes routes as follows: (1) *Sunset Route*—between San Francisco and Los Angeles, Cal., El Paso, San Antonio and Houston, Tex., and New Orleans, La.; (2) *Atlantic and Gulf Steamship Lines*—between New Orleans and New York, Galveston and New York and New Orleans and Havana, Cuba; (3) *San Joaquin Valley Line*—between San Francisco and Los Angeles, Cal.; (4) *Coast Line*—between San Francisco and Los Angeles, Cal.; (5) *Ogden Route*—between San Francisco and Ogden, Utah; (6) *Shasta Route*—between San Francisco, Sacramento and Portland, Ore.

Operating and Other Income.—The following tabulation, showing the number of shareholders, the miles of road operated and the results of operation in 1917, the last year of operation before the property was taken over by the government under the Federal Control Act of 21 March 1918, compared with 1886, the first complete calendar year of operation, gives an idea of the company's growth:

	Year ended 31 Dec. 1917	Year ended 31 Dec. 1886	Per cent of increase
Number of shareholders of Southern Pacific Company	37,088	91	....
Average miles of road operated	11,137	4,846	130
Freight revenue	$132,608,207	$18,668,421	610
Tons carried one mile	14,803,735,481	1,439,113,580	929
Freight-train miles	24,550,167	9,616,218	155
Passenger revenue	$45,380,193	$8,464,727	436
Passengers carried one mile	2,024,390,972	398,031,884	409
Passenger-train miles	31,085,797	5,953,054	422
Total operating revenues	$193,971,490	$31,797,882	510
Net revenue from miscellaneous operations, hire of equipment and rentals	8,080,390	284,797	2,737
Interest and dividends received and other income	7,248,979	544,535	1,231
Gross income	$209,300,859	$32,627,214	541
Operating expenses and uncollectible revenues	$120,672,060	$18,514,656	552
Railway tax accruals	13,792,176	888,623	1,452
Interest and other deductions	25,707,206	9,112,941	182
Total deductions	$160,171,442	$28,516,220	460
Net income	$49,129,417	$4,110,994	1,095
Per cent of net income on outstanding capital stock of Southern Pacific Company	17.65	3.27	439.76

In 1917 after appropriating $978,097 for sinking funds and $16,369,854 for dividends there remained a balance of $31,781,466 which went to swell the surplus of the company.

Capital Stock and Funded Debt.—At 31 Dec. 1917 the capital stock and funded debt were as follows:

Capital Stock:		
Southern Pacific Company	$272,823,405	
Proprietary Companies...	349,082,400	
		$621,905,805
Funded Debt:		
Southern Pacific Company	$206,657,610	
Proprietary Companies...	456,471,651	
		$663,129,261

Of the proprietary companies' issues the Southern Pacific Company owns direct or through subsidiaries $349,000,700 of capital stocks and $97,689,590 of funded debt. In addition to these holdings $11,471,000 of proprietary companies' bonds are held in sinking funds.

Assets and Liabilities.—The balance sheets of the Southern Pacific Company and its proprietary companies, translated into ordinary conversational language, show the magnitude of the company's property interests and financial strength: On 31 Dec. 1917 the combined obligations (debts) of every description, of the company and its proprietary companies, consisting of amounts owed to security holders, employees, tradesmen, connecting lines, tax collectors and others (not including $51,874,598.08 of accrued depreciation on road, equipment and miscellaneous physical property) amounted to $1,382,264,737.57. The companies held to meet such obligations assets (property) amounting to $1,685,075,159.29 as follows: (1) Book value of the investment to transportation property carried on the books of the companies forming the Southern Pacific steam transportation system, consisting of 11,165 miles of first-main track, 561 miles of additional main track, 4,150 miles of yard track and sidings, 25 ocean steamships, 5 river steamships, 18 ferry-boats and car transfers, 10 tugs, 63 barges and 19 other vessels, the whole forming a transcontinental system extending from New York City, via New Orleans and Galveston to San Francisco, Cal., and Portland, Ore., with a line extending from Ogden, Utah, to San Francisco, Cal., $983,482,275.20; (2) cash and interest-bearing securities in sinking funds for the redemption of outstanding funded debt, $13,711,547.27; (3) investments in miscellaneous physical property consisting principally of (a) the California Fuel-Oil Department of Southern Pacific Company with an annual production of about 9,500,000 barrels of oil and annual gross earnings of approximately $17,000,000, and (b) terminal and other real estate acquired in anticipation of future use, $30,778,341.24; (4) investments in affiliated companies, $523,560,538.04; (5) other investments, principally securities in outside companies, $24,730,955.60; (6) current, deferred and unadjusted assets consisting of:

Cash	$31,733,162 61	
Cash assets	27,319,549 20	
Material and supplies	24,406,115 91	
Deferred assets and unadjusted items	25,352,674 22	
		$108,811,501 94
Grand total of assets		$1,685,075,159 29

which exceeds all debts and obligations, including the outstanding capital stock, by an amount of $302,810,421.72, of which $51,874,598.08 represents reserves for accrued depreciation and $250,935,823.64 represents an invested surplus which is equivalent to nearly 92 per cent of the outstanding capital stock. In addition the companies own 10,978,818 acres of unsold subsidy lands, allocated thus: (a) Central Pacific Railway Company, 7,076,215 acres; (b) Houston and Texas Central Railroad Company, 18,688 acres; (c) Southern Pacific Land Company, 3,883,915 acres; total, 10,978,818 acres; and have a claim against the United States for the value of 2,353,446 acres of unsold lands of the Oregon and California Railroad land grant taken over by the government under Act of Congress passed 9 June 1916.

Union Pacific and Southern Pacific Unmerger.— Following the death of the late C. P. Huntington the Union Pacific Railroad Company acquired a large block of Southern Pacific Company stock and this was augmented by later purchases until on 30 June 1912 the Union Pacific owned $126,650,000 out of a total of $272,672,406 of Southern Pacific Company stock. Suit was brought by the United States on the ground that the ownership of such stock by the Union Pacific Railroad Company was in violation of the Sherman Law and on 2 Dec. 1912 the United States Supreme Court held that the ownership of such stock by the Union Pacific Railroad Company was unlawful and ordered the sale of such stock.

General.— The Southern Pacific Company was one of the pioneers in the use of all-steel equipment, the first all-steel passenger car used on its lines having been placed in service in July 1906. Since that time it has constantly been adding to its steel equipment and for several years has followed the practice of purchasing only all-steel cars for passenger service and either all-steel or steel underframe cars for freight service. Of the 2,405 passenger-train cars in service at 31 Dec. 1917, 1,096, or 46 per cent, were all steel, and of the 51,187 freight-train cars in service at the same date 37,515, or 76 per cent, were either all steel or steel underframe.

To secure and maintain the highest standard of efficiency and safety of operation the Southern Pacific Company has for many years expended large sums in the substitution of steel cars for wooden cars; in the application of air-brakes, automatic couplers and other safety devices; in the elimination or adequate protection of grade crossings; and in the installation of automatic electric-block signals. As a result of such expenditures for safety devices, and of the unremitting efforts of the company's officers to maintain safe-working methods, the company transported 422,000,000 passengers in the 10 years ending 31 Dec. 1917 *with but one fatality in a train accident.*

SOUTHERN RAILWAY COMPANY.

The Southern Railway Company was chartered under the laws of Virginia, 1894, as successor to the Richmond and West Point Terminal Railway and Warehouse Company. It operates main lines in Virginia, North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Kentucky, Indiana and Illinois. There are also branches and spurs in these States, also in the District of Columbia. The lines owned extend 4,341.60 miles; those controlled through the ownership of securities, 1,456.68 miles, and the leased lines, 786.03 miles. The road covers, with its leased lines and trackage rights, practically all points of importance in the South Atlantic and Gulf States.

The Southern Railway, by its ownership of securities, controls the following leased lines: Southern Railway, Carolina division, 755 miles; Mobile and Birmingham Railroad, 150; Richmond and Mecklenburg Railway, 31; Georgia Midland Railroad, 98; Virginia and Southwestern Railway, 189; North Carolina Midland Railroad, 54; Elberton Southern Railway, 51. The lines controlled but not leased are: the State University Railway, 10 miles; Knoxville and Ohio Railroad, 69; Sievern and Knoxville Railroad, 17; Ensley Southern, 33; Cumberland Railway, 11; Tennessee and Carolina Southern Railway, 30; Roswell Railroad, 13. Other lines leased and trackage rights bring the aggregate length of line controlled by the Southern Railway Company, as above, to 7,102 miles.

Other Lines Acquired.— The Southern Railway Company also controls the Mobile and Ohio Railroad; Alabama Great Southern Railroad, 357 miles; Cincinnati, New Orleans and Texas Pacific Railroad, 336; Georgia Southern and Florida Railway, 391; Northern Alabama Railroad, 119. During the fiscal year ended 30 June 1917 the company acquired practically all the capital stock of the New Orleans and Northeastern Railroad, extending from New Orleans to Meridian, Miss., 195 miles.

The Alabama Great Southern Railroad is controlled by the Southern Railway Company through ownership of the majority of each class of its capital stock. The Southern Railway Company controls the Mobile and Ohio Railroad through ownership of more than 73 per cent of its capital stock and about 87 per cent of its general mortgage bonds. The Georgia Southern and Florida Railway Company is controlled through ownership of more than 58 per cent of its capital stock and the entire issue of its first consolidated mortgage bonds. The above companies are operated independently. Other lines in the same class are: Northern Alabama Railway; Atlantic and Yadkin Railway; Blue Ridge, Danville and Western Railroad; Tallulah Falls Railway; Lawrenceville Branch Railroad; Hartwell Railway; High Point, Randleman, Asheboro and Southern Railroad; Saint Johns River Terminal, and Yadkin Railroad.

The operating revenues in the year ended 31 Dec. 1917 amounted to $90,716,569, earned by the transportation of 19,886,602 passengers and 37,063,095 tons of freight. The passenger travel averaged 55.99 miles at 2.183 cents per mile — aggregating in the year 1,113,473,875 passenger-miles and $24,303,183. The freight traffic averaged 175.81 miles per ton, at a charge of 0.897 cents per ton-mile — aggregating in the year, 6,516,208,527 ton-miles and $58,450,029. The total operating expenses for the year amounted to $60,113,508 and the total operating income was $26,429,962, of which $14,037,415 was net income. The appropriation for dividends was $1,500,000 and for physical betterments, $120,210. The surplus for the year was $12,417,205.

The equipment of the road on 31 Dec. 1917 comprised 1,750 locomotives, 626 passenger coaches, 345 baggage, mail and express cars and 49,495 freight cars, of which 18,480 were coal cars.

The entire investment in the road and its equipment was $416,468,542. Other investments of the company amounted to $75,752,539. The total stock outstanding was $180,000,000 and the long-term debt was $253,275,500. The credit balance of the profit and loss account on the date quoted was $43,288,162.

Descriptive.— The Southern Railway with its main artery extends from Washington, D. C., to Atlanta, Ga., where branches extend southward to Mobile, Ala.; eastward to Brunswick, Savannah and Charleston; westward to Chattanooga, Birmingham and Memphis; another westward branch also reaching Louisville and Saint Louis; while other ramifications extend to Harrisburg, Pa., Richmond, Va., and Norfolk, N. C.

SOUTHERNE, Thomas, English playwright and dramatist: b. in County Dublin, Ireland, about 1660; d. 26 May 1746. He was educated at Trinity College, Dublin, and entered the Middle Temple at London, but subsequently abandoned law to take up play-writing. His first play was 'The Loyal Brother, or The Persian Prince' (1682); this was followed by 'Isabella or the Fatal Marriage' (1694), which was afterward revised by Garrick; 'Oroonoko, or The Royal Slave' (1696), one of the earliest English condemnations of the slave trade; 'Sir Anthony Love, or The Rambling Lady.'

SOUTHERNWOOD, an ornamental and ordinary herb. See ARTEMISIA.

SOUTHEY, south'i or suth'i, **Caroline Ann Bowles,** English poetess, daughter of Capt. Charles Bowles, a retired officer, and second wife of Robert Southey (q.v.), to whom she was married in 1839: b. Lymington, Hampshire, 6 Dec. 1786; d. there, 20 July 1854. Owing to the death of her mother in 1816 and the loss of her property she was compelled to turn to literature for maintenance and in 1820 sent the manuscript of 'Allen Fitzarthur' to Robert Southey for approval. This led to considerable correspondence between them and finally resulted in their marriage in 1839. Meanwhile she had written 'Tales of the Factories' (1823) in verse; 'Solitary Hours' (1826) in verse and prose: 'Chapters on Churchyards' (1829), prose tales which gained her wide reputation; 'Selwyn in Search of a Daughter' (1835); 'The Birthday' (1836), etc. She also collaborated with Southey on the poem 'Robin Hood,' which was not, however, completed. After Southey's death she lived in retirement. Her collected poems were published in 1867. For bibliography see SOUTHEY, ROBERT.

SOUTHEY, Robert, English poet-laureate, historian, miscellaneous writer: b. Bristol, England, 12 Aug. 1774; d. Keswick, England, 21 March 1843. His father was Robert Southey, a linen draper; his mother was Margaret Hill, daughter of Edward Hill, gentleman, of Bedminster. Southey spent most of his boyhood in the care of his mother's half-sister, Miss Elizabeth Tyler of Bath. She gave him access to the theatre and to books, and, in his 14th year, sent him to Westminster School. There he remained four years; then, for publishing in the school paper a protest against excessive flogging, he was privately expelled. His mother's brother, the Rev. Herbert Hill, sent Southey to Oxford. He matriculated at Ballio College, 3 Nov. 1792. In his regular studies he was but little interested; but he read much and was especially influenced by the stoicism of Epictetus.

Southey's first important literary work, 'Joan of Arc,' an epic in 12 books, he composed during his summer vacation, 1793. He intended it as a tribute to the principles of the French Revolution; but the execution of the Girondins in October of that year cooled his enthusiasm. Then in June 1794 he found a new outlet for his ardor in the scheme of "pantisocracy" proposed to him by Samuel Taylor Coleridge. For lack of funds their plan for a colony on the banks of the Susquehanna ultimately failed. Southey was glad to accept an invitation from his uncle, the Rev. Herbert Hill, to visit Lisbon. The intended emigration, however, had one permanent effect: Southey had engaged himself to Edith Fricker; Coleridge, to her sister Sara. Before Southey sailed for Lisbon he married Edith, 14 Nov. 1795.

This marriage proved a great steadying influence on Southey's life. Returning from the Peninsula early in 1797, he made a serious attempt to study law, and, finding that he lacked ability in this, transferred his efforts to earning a livelihood with his pen. Within three years, besides much miscellaneous work, he published 'Minor Poems' (1797), completed 'Madoc' and planned 'Thalaba' and a 'History of Portugal.' In 1800 illness drove him again to Portugal, where he gathered material for his 'History' and completed 'Thalaba.' Recovered in health, he accepted a secretaryship to Isaac Corry, chancellor of the Irish exchequer, "a foolish office and a good salary" which he soon resigned. Back in England, he removed in 1803 from Bristol to Keswick. There Coleridge was established in "Greta Hall," and of this house Southey — to enable his wife to be near her sister, Sara Coleridge — took one-half. In 1809 he became owner of the entire house and harbored with his own the family that Coleridge had deserted.

Here was Southey's home for life. Here were born all but the first of his seven children. Here he brought together his library of 14,000 volumes. Here he did his work: kept in hand the epics from which he hoped for fame; gathered materials for that great history of Portugal destined never to be written; ground out the translations, histories, biographies and magazine articles, the glorified hack-work by which he met the growing needs of his own family and that of Coleridge. Pantisocracy, despite the pleadings of Coleridge, Southey had abandoned. But Southey had found a more practical idealism: he worked steadily and cheerfully; he met his business engagements punctually; he aided younger literary aspirants with money and advice; and, although no longer as in youth a revolutionist, he championed in print more than one cause of progress and reform.

His work was not unrecognized. The *Quarterly Review,* to which, between 1808 and 1839, he contributed 95 articles, paid him during the latter part of that period £100 for each. In 1813 he was made poet-laureate. In 1820 Oxford conferred on him the degree of D.C.L. In 1826, without his knowledge, he was elected member of Parliament for Downton; and, when he protested that he lacked the proper qualification, Sir Robert Inglis promptly proposed that an estate of £300 a year be purchased for him. Southey, averse to public life, declined this offer, as he did that of Sir Robert Peel, in 1835, to make him a baronet. Peel, however, found means to be of use to Southey, for, by a general act for the recognition of distinguished services to literature and science, he obtained for Southey a pension of £300.

The last years of Southey's life were sad. On 2 Oct. 1834 he wrote: «I have been parted from my wife by something worse than death. Forty years she has been the life of my life; and I have left her this day in a lunatic asylum.» In the spring they brought her back to Greta Hall. In the autumn she grew weaker. On 16 Nov. 1835 she «passed quietly ‹from death unto life.›» Southey himself, still physically strong, was beginning to show mental weakness. In 1839 he married Caroline Bowles, the poetess, a friend of the Southeys for 20 years. Of his condition in 1840, Wordsworth wrote: «Southey did not recognize me till he was told. Then his eyes flashed for a moment with their former brightness, but he sank into the state in which I had found him, patting with both hands his books affectionately like a child.» He died 21 March 1843.

Southey's literary work falls roughly into two groups: his poetry, for the most part early, before he was 30; his prose, for the most part later. The first group consists chiefly of long narrative poems: ‹Joan of Arc› (1796); ‹Thalaba› (1801); ‹Madoc› (1805); ‹The Curse of Kehama› (1810), and ‹Roderick, the Last of the Goths› (1814). Legendary or mythological in subject, these poems embody in an exotic setting — Gothic, Arabian, Hindoo, whatnot — their author's high-souled ethical ideals. For their setting and their philosophy these poems are worth reading but they are lacking in vital relation to life. Southey's stoicism made expression of lyric emotion unnatural, and he was too sincere to feign. Of the poems that he wrote as laureate — ‹Carmen Triumphale› (1814); ‹The Poet's Pilgrimage to Waterloo› (1816); the ‹Ephithalamium› and the ‹Elegy for the Princess Charlotte› (1817); ‹The Vision of Judgment› (1821), and ‹A Tale of Paraguay› (1825) — the ‹elegy› and the ‹Tale› are the best. Southey's ‹Poetical Works collected by himself› were published at London (10 vols., 1837–38).

His best work, however, was done in prose, notably in his ‹Life of Nelson› (1813), and his ‹Life of Wesley› (1820). His scholarly ‹History of Brazil› (1810–19) is unfortunate in its subject. His ‹History of the Peninsular War› (1823–32) is defective in its grasp of military movement and has been superseded by that of Sir William Napier. Of his translations of mediæval romances, the best is his ‹Chronicle of the Cid› (1808). Chief among his other prose works are ‹Omninia› (1812); ‹The Doctor› (1834–37); ‹Sir Thomas More, or Colloquies on the Progress and Prospects of Society› (1829); ‹Life of Cowper› (1833–37), and ‹Lives of the Admirals, or Naval History of England› (1833–40). And yet, among all his works, both prose and poetry, Southey will perhaps live longest by his nursery classic of ‹The Three Bears› and by his verses ‹After Blenheim.›

Southey was not a genius. He is not even to be classed with his friends, Wordsworth, Coleridge and Scott. Byron wrote truly when he said that Southey

> ". . . had written much blank verse and blanker prose,
> And more of both than anybody knows."

But Southey was at least a faithful workman and a worthy man. As even Byron admitted, he was for his time «the only existing entire man of letters.»

Bibliography.— The best brief biography is that by Edward Dowden in the ‹English Men of Letters› series (1879). Consult also Southey's letters, edited in six volumes by Rev. C. C. Southey (1849–50); in four volumes by Rev. J. Wood Warter (1856); and in the single volume edited by John Dennis (1887); Saintsbury, G. E. B., ‹Southey› (in ‹Cambridge History of English Literature,› Vol. II, New York 1914).

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SOUTHINGTON, suth'ing-tŏn, Conn., town in Hartford County, on the New York, New Haven and Hartford Railroad about 25 miles north of New Haven and 18 miles south by west of Hartford. It is on a small stream, Quinnipiac River, which furnishes considerable waterpower. The chief manufacturing establishments are hardware works including carriage supplies and drop forgings. Other establisments produce cutlery, ceiling and floor plates, tinmen's supplies, wood screws, shoe calks and rolling mill. In 1900 there were in Southington 65 manufacturing establishments, with a capital investment of $2,783,709; the number of employees, 1,415; the wages paid annually, $627,604; the cost of raw material, $797,102, and the value of the product $1,994,564. The educational institutions are the Lewis High School, the public elementary schools, «Lincoln School.» There is a savings bank and one trust company; the combined capital of the banks is $100,000. Pop. 6,516.

SOUTHPORT, England, in Lancashire, a fashionable seaside resort on the northwestern coast, about 18 miles by rail north of Liverpool. There is a fine beach as far as the latter town. The main street terminates in a public park, and the esplanade commands beautiful views of the Welsh Mountains. Attractive features are the Pavilion and Winter Gardens, which include an opera-house and concert-hall; marine drive and gardens; Cambridge Hall; Public Library and Art Gallery; Grecian town-hall; Victoria Baths, finest and largest in the kingdom; Victoria Schools of Art and Science, and hospital. There are numerous churches and about 200 schools; the museum stands in the fine botanic gardens. Pop. about 7,500.

SOUTHWARK (South'wark. sometimes suth'erk), a metropolitan and parliamentary borough of central London, on the right bank of the Thames, and is, as its name implies, the south town. It came under the jurisdiction of the city in 1327. The choir and lady chapel of the Cathedral of Saint Saviour is the best example of early English architecture in London. The poets Gower, Fletcher and Massinger were interred in this church. The Roman Catholic Cathedral of Saint George is an imposing structure. The Metropolitan Tabernacle (associated with Charles Spurgeon) and Guy's Hospital are in the borough. Bankside Theatre, the scene of the first production of Shakespeare's plays, is on the river's bank. Marshalsea Prison is no longer in existence. John Harvard, the founder of Harvard College, was born in the Saint Saviour's district, but the house has been demolished. Pop. about 191,907. Consult Besant, 'South London' (1899); Boger, 'Bygone Southwark' (1895); Bower, 'Sketches of Southwark, Old and New' (1903); Manning and Bray, 'History of Surrey' (1804–05); Rendell, 'Old Southwark and Its People' (1878); Rendell and Norman, 'The Inns of Old Southwark' (1888); Thompson, 'Southwark Cathedral: Its History and Antiques' (1907).

SOUTHWELL, Robert, English poet and Catholic martyr: b. Horsham, Norfolk, about 1561; d. Tyburn, 21 Feb. 1595. He was educated at Douai and Paris under Jesuit influence and was ordained to the priesthood in 1584. In 1586 he returned to England, but owing to the penal laws against Catholics and especially against priests, was obliged to live in the greatest seclusion. In 1589 he became domestic chaplain to the Countess of Arundel and composed various pieces of prose intended to give comfort and encouragement to his co-religionists in their trials. Chief among the objects of his solicitude was the Earl of Arundel, under sentence of death in the Tower. On 20 June 1592 Southwell was arrested for visiting the house of Richard Bellamy, a Catholic under suspicion. He was many times tortured in order to extort from him confessions that might be used in prosecuting other Catholics; but his only answer was that he was a Jesuit and was prepared to die. In February 1595 he was tried for treason under the statute that prohibited the presence in England of Jesuits or seminary priests. He was hanged, drawn and quartered at Tyburn. Shortly after his execution collections of his poems were published and many subsequent editions have appeared. A collected edition was edited by Walter in 1817 and by Turnbull in 1856. Of his verse the most notable examples are 'Saint Peter's Complaint' and the 'Burning Babe,' a beautiful Christmas carol, of which there are different modern musical settings. Of his English prose tracts, 'Mary Magdalen's Teares' may be mentioned. His 'Complete Poems,' edited by Grosart are published in the 'Fuller Worthies Library' (London 1872).

SOUTHWEST TERRITORY, a territory of the United States, comprising all the region ceded by North Caroline (now Tennessee) and the narrow strip ceded by South Carolina. This was organized in 1790 as the Southwest Territory, with institutions resembling those of the Northwest, except for the admission of slavery. With the admission of Tennessee, in 1796, and the organization of the Mississippi Territory, in 1798, the Southwest Territory went out of existence.

SOUTHWESTERN BOUNDARY. See BOUNDARIES OF THE UNITED STATES.

SOUTHWESTERN COLLEGE, a coeducational institution of higher learning established at Winfield, Kan., in 1886. It is under the control of the Methodist Episcopal Church and gives collegiate, academic, music, business, art and oratory courses. It grants the degree B.A. and is accredited by the State for the granting of teachers' certificates. In 1918 it had 300 students enrolled, 200 with the colors and 20 teachers.

SOUTHWESTERN LOUISIANA INDUSTRIAL INSTITUTE, coeducational institution at Lafayette, La., founded in 1898 by the State of Louisiana. Its first session began in September 1901. Six courses of study are given, as follows: The academic industrial course, teachers' course, teachers' course in agriculture and farm mechanics' teachers' course in home economics, one-year course in commercial accounting and a one-year course in stenography. A summer term of nine weeks is conducted by the Industrial Institute each year to enable its students in the teacher-training courses to continue their work from summer to summer while engaged in teaching during the regular session. The institute owns 50 acres of land, of which 25 are in use for the buildings and campus. It also rents about 100 additional acres for the needs of the demonstration farm. The buildings and equipment are valued at $175,000. The attendance for 1915–16 was 372, and there were 29 instructors. Its income in 1915 amounted to $107,749.83, of which $88,750 was contributed by the State.

SOUTHWESTERN UNIVERSITY, located at Georgetown, Tex., established by the five Texas Conferences of the Methodist Episcopal Church, South. The movement for the establishment of the university was begun in 1869, the first session was opened in 1873 and the charter obtained in 1875. The charter rights of Ruterville College, Ruterville, McKenzie College, Clarksville, Wesleyan College, San Augustine and Soule University, Chappell Hill, were transferred to Southwestern University by order of the conferences and by special acts of the State legislature. Shortly after the establishment of the university, the need of college education for women in the South led to a movement which resulted in the organization of the Ladies' Annex. Originally the Annex was under the charge of the same faculty, but all classes were separate; exception was made in the case of scientific laboratory work. In 1900 the Annex was more closely affiliated with the university, and the women students of the Annex admitted to all college classes with men. The degrees conferred are B.A., B.S., B. Music, M.A., and M.S. The School of Fine Arts offers instruction in art, elocution and music. The campus is in three tracts, the Fitting School campus, the Annex campus and the College campus. Giddings Hall, a dormitory for men and five residence cottages are near the Fitting School; a new college building was completed in 1900 for scientific laboratories and the library. The students in 1918 numbered 877, the instruction staff, 34. A library of 30,000 volumes is maintained.

SOUTHWORTH, Emma Dorothy Eliza Nevitte, American novelist: b. Washington, D. C., 26 Dec. 1819; d. there, 30 June 1899. In 1840 she was married to Frederick H. Southworth of Utica, N. Y., was thrown upon her own resources two years later and engaged in teaching in Washington in 1844–49. Her first story, 'The Irish Refugee,' appeared in the Baltimore *Saturday Visitor,* and she subsequently wrote for the *National Era* and the New York *Ledger.* Her work is characterized by some dramatic power and is still popular with uncritical readers, having been republished abroad and translated into several languages. She was a prolific writer and more than 60 novels were originally issued serially. A uniform edition of her works beginning with 'Retribution,' including 'The Hidden Hand,' which was successfully dramatized, and ending with 'The Fatal Secret,' was published in 42 volumes in 1872. Among her later works are 'Unknown' (1874); 'Mother's Secret' (1883); 'An Exile's Bride' (1887).

SOUTHWORTH, Franklin Chester, American Unitarian clergyman: b. North Collins, N. Y., 15 Oct. 1863. He was graduated from Harvard in 1887 and from the Harvard Divinity School in 1892. From 1887 to 1889 he taught Latin and Greek at Fish's School for Boys in Worcester and at the Adams Academy, in Quincy, Mass. Entering the university he was pastor of the First Unitarian Church, Duluth, Minn., 1892–97, and of the Third Unitarian Church of Chicago, 1897–99. In 1899 he became secretary of the Western Unitarian Conference, an organization composed of all the Unitarian churches in the Central West, among which he traveled extensively for three years, preaching, lecturing and attending conferences. In 1902 he became president of the Meadville Theological School and professor of practical theology, which position he still holds. In 1909 he gave a series of lectures in Manchester College, Oxford, England, and gave a number of sermons and addresses at London, Liverpool, Manchester and other English cities. He has three degrees from Harvard, was awarded the degree of doctor of divinity by Buchtel College in 1911 and the degree of doctor of laws by Allegheny College in 1915.

SOUVESTRE, soo-vĕstr, **Emile,** French novelist and dramatist: b. Morlaix, 15 April 1806; d. Paris, 5 July 1854. His literary work was an issue aside from the business of his life, and he was successively clerk, schoolmaster, journalist and in 1848 professor of administrative style in a civil service school. His 'Un philosophe sous les toits' was crowned by the academy in 1851 and in the August following his death his widow received the Lambert prize founded in honor of the memory of the writer who had conferred the highest service. He was the author of 'Derniers Bretons' (1835–37), and 'Foyer Breton' (1844), works embodying the folk-lore and natural features of his native province; also 'Pierre et Jean' (1842); 'Confession d'un ouvrier' (1851) and other fictions; besides dramas, works of travel and biographies. His principal contribution to literature consists in the vivid pictures he has given of the life and manners of the Bretons.

SOVEREIGN. (1) *In politics* the highest person in a State; applied also adjectively to the highest power in a State, or to a State which exercises supreme or independent authority. Thus the legislature in its various branches is the sovereign power in each State, though the name of sovereign in a limited monarchy is reserved for the monarch, and a State which owns no superior is termed a sovereign State. (2) a gold coin, the standard of the English coinage. It exchanges for 20 shillings sterling, or about $5.

SOVEREIGNTY, *in political science* the supreme power in a State by which the government is administered. In republics generally it is held that sovereignty resides in the people, but in some countries, like Japan, it is held that it is possessed by the sovereign. Various theories have been advanced as to the origin of sovereignty, some contending that it is the prerogative of the stronger force, others that it is created by divine sanction and still others that it is created by voluntary contract or that it is a property right descending in regular line of succession. Milton and Locke in the 17th century contended that the people were the ultimate source of political authority and the same principle was advanced by the French Revolution. The Declaration of Independence asserted the same doctrine when it declared that "governments derive their just powers from the consent of the governed," and in political addresses of the time the principle was frequently enunciated in all sections of the country that the people had the right to alter their governments whenever and in whatsoever manner they deemed expedient. These principles were embodied in the State constitutions, and even the right of revolution was therein asserted. The doctrine of popular sovereignty is almost universally accepted in Europe at the present time.

Sovereignty is of two kinds: internal and external. Internal sovereignty includes all governmental powers which a State possesses over its own citizens or foreigners domiciled therein and over private ships on the high seas. External sovereignty includes the right to enter into relations with foreign states, as by treaty or by declaring war.

There has been much contention as to whether each State in the Union is vested with sovereignty or whether it resides solely in the United States. The prevailing view is that the sovereignty of a State is legally limited and, therefore, not absolute, although before the Civil War this view was not at all general.

Internal sovereignty is divided into political sovereignty and legal sovereignty. Political sovereignty is the final supreme power residing in any political society. Legal sovereignty is the power which is in legal control at any specified period. Other distinctions are de facto and de jure sovereignty, the former of which is sovereignty that has been assumed but is obeyed by the citizens, though not resting on a legal basis, and the latter of which is sovereignty founded on law. Some authors refuse to recognize these two distinctions.

A State may have internal sovereignty but not external sovereignty, as by yielding its right to make war or to negotiate with other States. In international law, however, such States, while subject to other States, are treated as sovereign powers. Under this head are included protectorates and suzerainties.

Some recent writers advocate the elimination of the term sovereignty from political science on the ground that it is synonymous with absolutism and should not be applied to the supreme power in any constitutional, Federal or similar government.

SOVIET (pron. sävyet'), a Russian word signifying council, advice, harmony, concord; sovietnik=councillor. Under the old régime the Tsar's Council of Ministers was called the «Soviet of Ministers,» but the term has been invested with a new meaning since the Russian Revolution of March 1917. The popular organizations which then came into existence were called «Councils of Workmen's and Soldiers' Deputies,» bodies which were supposed to be holding things together under the provisional Government until the election of the Constituent Assembly could take place; in a sense, they were vigilance committees designed to guard against counter-revolution. The Petrograd Soviet of 4,000 members was the most important of these, on account of its position in the capital and its influence over the garrison. By degrees the orderly and moderate element was pushed out of this group and the extremists who demanded «all power to the soviets» became supreme. When the Constituent Assembly eventually met, the Bolsheviki and their allies were in a minority, yet they succeeded in breaking up the Assembly and finally came out with their own program, the so-called «soviet government.» Chaos and disorders paralyzed the upholders of constitutional democracy because they lacked both authority and the power to restrain the wild elements. The latter, on the other hand, possessed the Red Guard, a powerful armed mob, while the Soviet leaders — mainly ambitious doctrinnaires — saw in the instrument of their creation a road to fame and power. Soon the Soviet system was invested with intellectual justification as «a higher type of State» and «a higher form of democracy» which would «arouse the masses of the exploited toilers to the task of making new history.» Furthermore, it offered «to the oppressed toiling masses the opportunity to participate actively in the free construction of a new society.» According to Lenine, the author of these quotations, Soviet rule «is nothing else than the organized form of the dictatorship of the proletariat.» A loose code of rules governing elections to the soviets was framed, but the following classes were disqualified to vote: «Those who employ others for profit; those who live on incomes not derived from their own work — interest on capital, industrial enterprises or landed property; private business men, agents, middlemen; monks and priests of all denominations; ex-employees of the old police services and members of the Romanoff dynasty; lunatics and criminals.» With village and factory soviets as a base, there arises a vast pyramid of district, cantonal, county and regional soviets, each with its executive soviet. Over and above these stands the «All-Russia Soviet Congress,» which appoints an All-Russian Central Executive Committee of not more than 200 members, which in turn chooses the Soviet of People's Commissaries — the Ministry. Beginning with a minimum of three and maximum of 50 members for smaller communities, the maximum for town soviets was fixed at 1,000 members. According to its founders, this system is destined in the future to replace all other forms of government in the world.

For good or ill, a new system of government has appeared in Sovietism. Not a little speculation has been aroused in countries outside of Russia and a considerable number of political thinkers have analyzed the future possibilities of Soviet rule. The reign of terror and bloodshed which accompanied that rule in Russia may be regarded as an accidental transitory phase in the history of a country where violent occurrences are no novelties. It is necessary to separate barbarity and invidious class distinctions from Sovietism itself and to consider the latter purely as a political experiment of some importance. The essence of the conflict between the Parliamentary and the Soviet systems is whether the basis of representation shall be political or economic, using these words in their narrowest sense. The conception of the Soviet as ultimately representative of the local economic groupings — factories and productive areas — explains the enthusiasm of the neo-Marxians (who admit no politics outside the economic sphere) for the Soviet system, the elements of which they see in the works committees and such like combinations in modern large-scale industry. Some admirers, however, regard the Soviet system as a dual one with parallel political and industrial organizations, though it is probable that in practice the two branches merge in a single channel, the economic. Here we have only to ask whether a factory's political Soviet would be likely to work independently of its economic Soviet to realize that a separate standpoint is possible only in theory. The Soviet government in Russia claims to be in such close relations with the proletarian organizations on which it is based that «at all times the greater part of the population joins in the administration of the state» and that every worker may initiate in his Soviet a plan for reorganizing his industry which has only to be examined by the Sovets higher up and ratified to become law! If the Soviet system really fulfilled its claim to instruct the elector by giving him actual administrative experience, this would be a good argument in its favor, but in practice the demagogue and the party man dominate the high Soviets and these in their turn lord it over the lesser bodies. Hence the value of the system as an administrative training school disappears and the machine offers nothing useful that could not be obtained by Parliamentary government. Many sincere democratically-minded people in other countries have grown dissatisfied with their systems of Parliamentary government and have consequently been half prepared to welcome the Soviet idea as an alternative. Various causes have been advanced as being responsible for diminishing the prestige of Parliaments, such as their remoteness from public opinion, which elects but cannot recall them; the congestion of legislative business and the difficulty of carrying out necessary reforms;

the party system and the caucus; the corruption arising from personal and corporate pressure and the encroachments of cabinets. The Soviet system professes to remove these defects and also to introduce reforms which seem unattainable under Parliamentary government one of the chief being the creation of small and compact local administrative units to replace the existing large and unwieldy geographical electoral units. Many theorists, indeed, regard the Soviet system not as necessarily an instrument of proletarian dictatorship, but rather as a federation of local electoral groups, which, guided by intelligence and with toleration, could be transformed into a genuinely democratic form of government. Others, again, vision a possibility of separating the political and industrial spheres, while extending to both the means of self-government. In comparing existing institutions with visionary alternatives the advocates of the latter not infrequently fail to foresee the many defects which are not immediately apparent, but must inevitably be expected to arise. In no country have both these systems been fully tried, for Russia has never had real Parliamentary government, and in Bavaria, where a Soviet republic was established in February 1919, the venture so far has not presented the unassailable argument of success. It is difficult to see that the Soviet system can claim any tangible advantage over its rival, especially as the apex of the Soviet pyramid is far more remote from the individual elector than any Parliament or Congress. Altogether it seems easier and safer to overhaul and improve the solid machinery of a stable government than to cast it aside in favor of an abstract conception of doubtful value.

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SOW-THISTLE, a genus (*Sonchus*) of herbs of the order *Compositæ*. The species, of which there are about 30, are natives of the Old World, but some have become widely naturalized in temperate climates. They have alternate leaves, blue or yellow flowers in heads and beaked seeds crowned by fine white down. The common sow-thistle (*S. oleraceus*) is an annual which grows about 30 inches tall, has yellow flowers, and is found usually in rich soils. Its young leaves and tender tops are used as a substitute for spinach in northern Europe. The alpine sow-thistle (*S.* or *Lactuca, alpina*) is a native of mountainous Europe. It has beautiful blue flowerheads. The beach sow-thistle (*S. maritimus*) grows in saline soils in southern Europe, and is specially attractive because of its yellow flower-heads. These species are sometimes cultivated in gardens.

SOWER, or **SAUR, Christopher**, German-American printer: b. Laasphe, near Marburg, Germany, 1693; d. Germantown, Pa., 25 Sept. 1758. After a study of medicine at Halle, he came to Philadelphia in 1724, was for a time a farmer in Lancaster County, but in 1731 removed to Germantown, where he acted as an importer of German Bibles and religious works. In 1738 he obtained a printing-press and began the publication in German of a 24-page almanac, which continued to appear until 1798. He began in 1739 *Der Hoch-Deutsch Pennsylvanische Geschichtschreiber*, a religious and secular magazine, the first periodical in German in the United States. It was published at first quarterly at three shillings per annum and afterward monthly. He established (1738) the first type-foundry in America, made his own ink for printing and later manufactured his paper and did his binding. In 1743 he published, in German, a Bible of small quarto size, Luther's translation, the edition being limited to 1,200 copies of 1,284 pages. With the exception of Eliot's Indian Bible, this was the first Bible printed in the colonies and it was the largest work that had then been attempted. An English Bible was not printed until 1781 by Robert Aitken at Philadelphia. Sower may have invented cast-iron stoves; he introduced them into general use. Consult Thomas, 'History of Printing in America' (1870); Ringwalt, 'Encyclopædia of Printing' (1871).

SOY BEAN, a leguminous plant (*Glycine hispida*), sometimes incorrectly called soja bean, native to southeastern Asia. It has been cultivated from ancient times and in some countries, notably Japan, it forms an important article of food. It was introduced into England in 1790 and into America some years later, where it was first grown principally in the southern States. Its use as a food for man has not become general except in its original home in Asia, and it is only within recent years that its value as a feed for stock has brought it to the attention of the western countries. The soy bean is an annual, two to four feet high. It has branching, hairy stems with trifoliate, hairy leaves. The flowers are inconspicuous, of pale lilac or violet color, and the fruit is a broad, two- to five-seeded pod, covered, like the rest of the plant, with stiff, reddish hairs. The seeds vary in color according to variety. When grown for the seed the crop sometimes yields as high as 40 bushels or more to the acre, but the average is much less. As a forage crop it makes as high as two to three tons of cured hay per acre. The fact that the flowers are self-pollinated gives it an advantage over many other legumes in introducing it into new regions. (See Dolichos). Innumerable varieties and forms of the soy bean have been developed in the original home of the plant. Several different varieties have been introduced into the United States, these being distinguished largely according to the shape, size and color of the seed, in the degree of hairiness and in the time required for the plants to reach maturity. The early varieties are preferred when the plant is grown for seed, while the latter give better results as forage crops. Some of the advantages claimed for it as a crop are that it is able to gather the food of sustenance in relatively poor land and by its power to assimilate nitrogen from the air to enrich the soil in which it grows. It is relatively sure of producing a crop of seeds very nutritious to livestock, for which it is adapted to use in various forms.

Soy beans require about the same conditions for growth as corn, but have somewhat better powers of resisting drought. The seed is not planted until the ground is thoroughly warm in the spring, and the earlier varieties are grown with fair results by planting after an early grain crop has been harvested. When planted for forage the seed is often sown broadcast, but where a crop of beans is desired it is better to plant in drills. The stage of growth at which to harvest depends upon the use to be made of the crop. In the United States the soy bean is grown exclusively as a feed for stock, in pasture, as a soiling crop, for hay, or as a green manuring crop. The green feed and hay are excellent for cows in milk. The beans are usually fed in the form of meal and owing to the richness in protein and fats have been found of peculiar value in compounding feed rations. Fed in connection with less concentrated feeds and grains having a lower protein content, results have been obtained that show the soy beans to compare favorably in feeding value with cottonseed meal. The peanut is the only raw vegetable that contains as high a percentage of digestible protein and fat.

The soy bean is prepared for use as human food in a variety of ways in Japan, where it furnishes the protein that is lacking in a diet of rice. The plant is also grown in Europe and used there to a limited extent as human food. Since the beans contain no starch they are sometimes recommended as food for persons suffering from diabetes; a soy-bean bread has been manufactured for this purpose. Under the name of coffee bean, the soy beans have been placed on the market in America as a substitute for coffee.

In the United States the soy bean is best adapted to the southern and central States. It is not adapted to the States along the northern border or to the States west of the Rocky Mountains. In those States where it thrives it is especially valuable to soils that have become depleted of their nitrogen. The chemical composition of both bean and fodder adapts it especially to use as a balance ration in connection with corn and makes its cultivation desirable where no other protein feed is available. Consult 'Farmer's Bulletin' (Nos. 58, 372, 509, United States Department of Agriculture, Washington 1897–1914).

SOYER, swä-yā, **Alexis Benoit**, French cook: b. Meaux-en-Brie, 1809; d. England, 5 Aug. 1858. Leaving Paris in 1830, he served the Duke of Cambridge and became the chef of the Reform Club, 1837–50. In 1847 he received an appointment from the government to go to Ireland, which was then suffering from famine, and there he built several kitchens and served food at about half the ordinary cost. In 1855 he went to the Crimea, reorganized the victualing of the hospitals, improved the food of the army and navy and introduced cooking wagons. He was the most famous cook of his time and is immortalized as the Mirololant of Thackeray's 'Pendennis.' His writings on cookery were widely read and include 'Culinary Relaxations' (1845); 'Charitable Cookery' (1847); 'History of Food in all Ages' (1853); 'The Shilling Cookery Book' (1854). Consult Volant and Warren, 'Memoirs of Alexis Soyer' (London 1858).

SOYESHIMA, Tanéomi, Japanese statesman: b. Saga, Province of Hizen. At Nagasaki in 1866 he studied under Guido F. Verbeck, an American missionary, giving especial attention to the United States Constitution and the New Testament. In 1868 he became a commissioner for formulating laws and subsequently an imperial councillor. In 1871 he was sent to Siberia to adjust boundary questions relating to the island of Sakhalin. Returning to Japan he resigned his place in the Cabinet, but was later asked to return to it. On a visit to China in 1876 he was received with high honors by the mandarins by reason of his scholarship and he became private adviser of the emperor.

SPA, spä or spâ, **Belgium**, in the province of Liège, 20 miles southeast of the town of that name, a fashionable watering place, picturesquely situated, in an undulating country covered by woods and containing wonderful medicinal springs. There are delightful promenades in the environs. The casino, bath-house, public squares and hotels are interesting features, besides a new parish church and the Gallery Leopold II, with its museum, music-halls, reading-rooms, etc. Gambling was prohibited in 1902. The town is renowned for its lacquer ware. There are tanneries, forges and foundries. Spa was early famous as a resort and frequented by Russian and Swedish potentates and all the fashionable world. The generic term for mineral baths was thus derived. The waters are exported to the most distant countries and are efficacious in nervous diseases, anæmic troubles, dyspepsia and general debility. In 1918 the German general headquarters was located at Spa. Here took place the consultations of the general staff preceding the signature of the armistice and from here went forth the delegates appointed to meet Marshal Foch to sue for peace. Pop. 8,357. See WAR, EUROPEAN.

SPACE, that phase of the world which we express in terms of right and left, forward and backward, up and down, etc.; the actual experienced system which we are accustomed to handle by means of geometry. Many theories have been held concerning its nature. The ancient views are not at all clear, but until Aristotle, at any rate, the existence of empty space is not recognized and there is a general tendency to subordinate space to matter. The modern theory of space begins with Descartes, who makes extension the distinguishing mark of matter. Spinzoa, though he finds in matter an attribute of God rather than an independent substance, follows Descartes in this respect. Leibnitz does not attribute to space an independent existence, but makes it merely an unclear recognition of the logical relations of the monads. Newton on the other hand, claims an independent existence for space and maintains that position is absolute, not relative. Kant solves the dispute between Leibnitz and Newton by finding in space and time, respectively, that a priori form of the external and internal senses, so that geometry is independent of experience, yet spatial entities do not exist apart from sense. Among the present views on the subject is the curious one of Bergson, who regards the spatial description of the universe as a scientific, intellectual perversion of the temporal flux is directly presented to intuition.

The old dispute as to whether the idea of space is innate or acquired belongs to a past stage of philosophical discussion and one may take it as an established fact that the empirical status of extension is quite analogous to that of any of the sensory qualities. Just as my experience of this red blotter before me is preconditioned by the fact that I am so constituted — unlike some color-blind persons — as to be able to perceive red, so my experience of space depends on my having a nature fitted to perceive spatial entities. Indeed, it seems that as far as the mere nature of the experience is concerned, there is no reason for dividing qualities into the primary, such as those of space and time and the secondary, of color, sound, etc. The distinguishing characteristics of space reside in its organization rather than in its quality. This organization forms the subject matter of geometry, it is probably dependent in part on the intrinsic nature of the things which are in space and go to make up our spatial experience, but it is unquestionably also in a large measure dependent on the arrangement which we more or less consciously make of these sense-data, and by the arrangement of the entities of any system a system may be obtained whose formal properties are just about what you choose. Space thus becomes, as Poincaré has shown, a more or less pliable tool for scientific description, so that the question, «What is the structure of space?» may almost be translated into «What spatial structure is the simplest and most manageable for purposes of scientific description?» As a consequence, as the formulæ of science do not seem to be markedly simplified by the postulation of a non-Euclidean space (see Geometry, Non-Euclidean) or of any other spatial structure other than that which is familiar to us in our elementary geometry and as this elementary geometry is simpler in its formulæ than non-Euclidean geometry or other similar systems, we choose — albeit unconsciously — the structure of our space in such a way that it shall be Euclidean. The three-dimensional character of space is likewise due to the fact that a three-dimensional system forms the simplest and most appropriate background to the observed facts of physics and is not, as Kant supposed, an a priori truth. If we should suddenly find masses varying in such a manner as to be susceptible of an easy and direct explanation by a motion perpendicular to our space, the very next work on physics would speak just as confidently of a space of four dimensions as we now speak of a space of three. A change of a similar nature has taken place in the last few years. (See Relativity, The Principle of). Whereas space and time were formerly conceived as completely independent dimensions, the present attitude of physics is that a body in unaccelerated motion carries with it, as it were, a space which is essentially distinct from the space with reference to which it is in motion and that distances are not the same when measured with reference to two sets of axes in relative motion. In other words, the system of reference of modern physics cannot be divided into independent spatial and temporal parts, but constitutes an essentially homogeneous spatial-temporal manifold, which is a Euclidean four-dimensional space with real minimal lines. See Analytical Metrics.

The problems of the infinitude and the infinite divisibility of space and of unoccupied space are again matters of scientific convenience. It is far simpler for the scientist to have a system of reference which does not depend on the entities which are referred to this system than to be continually hemmed in by the limitations of matter and the construction of a system without lacunæ from a system which possesses them is no very difficult logical task. Consequently, the space of science is physically independent of its occupation by matter.

The problem of the extension of the world forms the subject matter of one of Kant's antinomies; that of its infinite divisibility is the subject matter of another. Both of these antinomies or paradoxes have a double aspect. Mathematically, they involve the motions of infinite collections and dense series, which have only received a satisfactory logical treatment within the last half-century. The infinitude of space and its infinite divisibility are again merely the results of the scientist's protest against the complications brought into his work by the supposition of a limited space or a space which offers obstacles to repeated division. Thus Kant is both right and wrong when he solves these antinomies by making space and time forms of perceptive experience, not things in themselves. He is right in so far as the infinitude and infinite divisibility of space emanates from ourselves and not from the object, but wrong in that he believes that infinitude and infinite divisibility involve unavoidable contradictions. (See Assemblages, General Theory of; Kant). Consult Bergson, Henri, 'Time and Free Will' (trans. by F. L. Pogson, New York 1910); Deichmann, 'Das Problem des Raumes in der grieschischen Philosophic bis Aristotles' (Leipzig 1893); Mach, 'Space and Geometry in the Light of Physiological, Psychological and Physical Inquiry' (trans. by J. McCormack, Chicago 1906); Poincaré, Henri, 'The Foundations of Science' (trans., New York 1913); Robb, A. A., 'Theory of Time and Space' (Cambridge 1914); Russell, B. A. W., 'Essay on the Foundations of Geometry' (Cambridge 1897).

SPACE OF DIMENSIONS. See Hyper-Spaces.

SPADA, spä'dä, **Leonello,** or **ESPADA,** Italian painter: b. Bologna, 1576; d. Parma, 1622. He became the pupil of Carrachos and César Baglioni and an intimate friend and imitator of Caravagio whom he considered his master and with whom he traveled. On his master's death he returned to Bologna and spent his latter days at the court of the Duke of Parma. Espada's power developed, when freed from the direct influence of Caravagio removed by the death of the latter. He developed a style until then unknown in painting, in which he showed a surprising mastery of color and of claro-obscurio and displayed creative talent uncommon even in his day. Among his works (which are well known in European galleries) are 'Santo Domingo,' represented as burning the heretical books (Santo Domingo Church Bosco); 'San Jerónimo' (in the same church); 'Abigail giving provisions to David for the Army' (in the church of the Madonna della Ghiara, in Reggio); 'Judith'; 'Esther'; 'The Madonna Crowned'; 'The Aurora' (frescoes and paintings in the same church). In Parma, where Espada was court painter to the duke, he decorated the theatre of the capital in such a fine style that there was none other equal to it in his day, and he left the mark of his genius everywhere throughout the city in the shape of talented paintings, among them being 'The Virgin and Saints' (in Santo Sepulcro);

'San Félix' (in Capuchinos); 'Christ' (in Steccata); 'Piedad' (in Santa Cataline College); 'Christ before Pilate'; 'Saint Peter Denying his Master'; 'Death of John the Baptist'; 'Judith' (in the city art galleries). Espada's paintings are scattered throughout most, of the larger cities of Italy and many of them have found their way outside the country. Among the best known of those not already mentioned are 'The Virgin and San Francisco de Asisi' (in Módena Gallery); 'Auto-retroto of Espada' (in Florence gallery); 'Christ tied to a Pillar' (in the Naples Museum); 'The Chastity of José' (Faragina gallery, Genoa); 'Jesus Crowned with Thorns'; 'David with the Head of Goliath'; 'Cupid Playing with a Leopard' (all in the Dresden Museum); 'Return of the Prodigal Son'; 'Death of San Cristóbal' (in the Louvre); 'Santa Cecilia' (Madrid Museum).

SPADE-FOOT TOAD, a toad (*Scaphiopus holbrookii*), resembling the common toad in general appearance but differing from it so greatly in structure as to be placed in a distinct family (*Scaphiopidæ*). They have teeth on both the upper jaw and the vomer bone; the bodies of the vertebræ are cupped in front; the sternum is altogether cartilaginous; the sacral transverse processes are greatly expanded; the pupil of the eye vertical and the side of the foot is provided with a plate-like appendage supported by cartilage, from which they take their name. The spade-foot is found throughout the eastern United States, but is in most places rare and of very uncertain occurrence, appearing suddenly in great numbers and as suddenly disappearing some seasons and again being entirely absent. It lives in burrows, from which it issues at night or after long-continued rains to feed on insects. Early in the spring it breeds, the eggs being deposited in temporary rain-pools. If the season be a dry one, development of the tadpoles is much quickened by the drying up of the water, but in wet seasons the larval period is extended. Most remarkable is the voice, which is so loud as to astonish all who hear it produced from so small an animal. These toads are very noisy during the period of reproduction, but soon after become quiet and disappear. Another species (*S. couchii*) is found in Texas and Mexico, five or six more in the latter country and three other species belong to western Europe and the Mediterranean region. Consult Dickerson, 'The Frog Book' (new ed., New York 1914); Gadow, Hans, 'Amphibia and Reptiles' (in 'Cambridge Natural History' Vol. VIII, London 1901).

SPADE GUINEA, an English guinea having a spade-shaped shield bearing the arms on the reverse. They were coined from 1787 to 1799, inclusive.

SPAETH, spāth **(Philip Friedrich) Adolph (Theodor)**, American Lutheran clergyman: b. Esslingen, Würtemberg, 29 Oct. 1839; d. 2 June 1910. He was graduated from the University of Tübingen, 1861, was called to Zion's Church, Philadelphia, Pa., in 1864 and was pastor of Saint Johannes German Lutheran Church, Philadelphia, 1867–1910. He was also a professor in the Lutheran Theological Seminary and was president of the general council of the Evangelical Lutheran Church in North America, 1880–90. His publications include 'Phœbe, the Deaconess' (1885); 'Faith and Life as represented by Martin Luther' (1887); 'Biography of Dr. Charles Porterfield Krauth' (1898).

SPAGHETTI, spą-gĕt'tĭ. See Macaroni.

SPAGNA, spän'yä, **Lo**, easel name of Giovanni di Pietro, Italian painter, active during the first quarter of the 16th century. He was born in Spain and hence the designation, by which he is generally known, «The Spaniard.» He was a pupil of Pietro Perugino, whose name is frequently applied to Spagna's work and a contemporary of Pinturicchio and others of his school. He was a painter of some considerable talent and a contemporary of Raphael, whom he has been accused of imitating. He seems to have been a member of a guild or company of notable painters who worked together, so that it is difficult to distinguish his work from that of his fellows. Very little is known of his life. He lived in Spoleto in 1516, where his masterpiece 'The Madonna Enthroned' was painted. The National Gallery in London contains his 'Agony in the Garden,' which was formerly attributed to Raphael. Among his notable works are 'Coronation of the Virgin' (at Todi); 'Nativity' (in the Vatican); 'Madonna' (in the Louvre); 'The Nine Muses' (in the Capitol at Rome); altar-pieces and frescoes (at Assisi, Spoleto and neighboring places).

SPAGNOLETTO, spän-yō-lĕt'tō, **Lo.** See Ribera, José.

SPAHIS, spä'hĭs, or **SIPAHIS**, a part of the Turkish cavalry, which is said to have been organized by Amurath I, the founder of the janizaries; but which, since the organization of the Turkish army on the European system, has given place to regular cavalry. The spahis were composed of two classes; one with red, the other with yellow banners. The usual arms of the spahis were a sabre, a lance, a jereed (a dart about two feet long, which was hurled with great strength and skill) and a second sabre, or rather broad-sword, attached to the saddle. Some of them had bows and arrows and also pistols and carbines; but they made little use of firearms. The French call a body of light cavalry raised in Algeria by the name of spahis. The name sepoys, given to native troops in India by the British, is the same word.

SPAHR, spär, **Charles Barzillai**, American publicist and editor: b. Columbus, Ohio, 20 July 1860. He was graduated at Amherst, 1881 and studied later at Leipzig. He was associate editor of the *Outlook*, 1886–1903 and since February 1904 has been managing editor of *Current Literature*. He has published several articles on economic topics and is the author of 'The Present Distribution of Wealth' (1896) and 'America's Working People' (1900). Consult Abbott, Lyman, 'One Who Loved His Fellowmen' (New York 1905).

SPAIN (Lat. *Hispania*, Sp. *España*), a kingdom the territory of which in Europe embraces more than four-fifths of the Iberian Peninsula, the small islands near the coasts, the Balearic Islands and the territory of Llivia, locked in France and separated completely from the rest of Spain; in northern Africa the possessions of Ceuta and Melilla, the islands of Peregil, Vélez de la Gomera, Alhucemas, Alborán and Chafarinas; off the western coast of Africa, the Canary Islands, and along or near that coast a continental district that, extending at the west of the Desert of Sahara between the capes Bojador and Blanco, is known as the Spanish Sahara and the territory of the Ifni River; and in the Gulf of Guinea the Islands of Fernando Póo, Corisco and Annobón, the islets Elobey Grande, Elobey, Pequeña, Banie, Leva and Bañe, and that part of the African continent denominated Spanish Guinea, on the Muni River. Spain also exercises a protectorate over the African coast from Cape Bojador to the southern frontier of Morocco. Situated in the southwestern part of Europe and separated from the main body of the European or Eurasian continent by the cordillera of the Pyrenees, the peninsular part of Spain extends from lat. 43° 27′ 25″ N. at Point Estaca de Vares to lat. 35° 59′ 50″ N. at the south point of Tarifa Island; from long. 3° 20′ E. of Greenwich (7° 0′ 28″ E. of Madrid) at Cape Creus to 9° 15′ W. of Greenwich (5° 37′ 03″ W. of Madrid) at Cape Toriñana. Its total area is given as 195,000 square miles, approximately, or (by Dirección General del Instituto Geográfico y Estadistico, 'Reseñn Geográfica y Estadistica de España' (Madrid 1912–14), 492,247 square kilometers, and its boundaries are: On the north the Cantabrian Sea or Bay of Biscay, France and the republic of Andorra; on the east the Mediterranean Sea; on the south the same sea, the Strait of Gibraltar and the Atlantic Ocean; on the west that ocean and Portugal.

Distinguishing physical characteristics are the high average elevation of the land above sea-level and the regularity of the coasts. The ratio of that part of the entire area lying below 1,600 feet to that part uplifted above 1,600 feet is approximately 23 to 36. In other words, more than three-fifths must be regarded as highlands, and the altitude of one-third of the highlands is over 3,200 feet. Excepting Switzerland, Spain is the highest of all European countries (mean altitude of the former 1,300 metres and of the latter 660 metres). It is even true that the mean elevation of the cordillera of the Pyrenees is greater than that of the Alps, although the latter has some peaks higher than the former; and the Sierra Nevada rises into the region of perpetual snows. In the centre of the country is a high region forming a secondary peninsula, so to speak, with a mean altitude of 2,000 feet, known as the meseta. The water-parting is in the eastern half of the country as a rule, the Ebro being the only Spanish river with a long course flowing into the Mediterranean. Excepting the Ebro Valley, then, the western slope is much more extensive and less abrupt than the eastern; and communication between the centre and the western littoral is naturally easier than between the centre and the Mediterranean; but Portugal has separated the most accessible maritime zone from the central highlands, and so Spain has kept an extensive littoral without any easy natural communication between it and the interior except the valley of the Guadalquivir. (See RIVERS).

The western slope is divided into five unequal bands by four mountain systems which bound the great valleys of the rivers Duero, Tagus (both mainly Portuguese), Guadiana (the lower course of which partly in Portugal) and Guadalquivir; leaving at the north a narrow band which sends its waters directly to the Cantabrian Sea (Bay of Biscay) and is bounded by that sea on the north and the Cantabrian Mountains on the south. All these cordilleras have a fundamentally east and west direction in Spanish territory, but change abruptly to take a northwest-southeast direction when Portugal is reached, and to some extent create barriers or obstacles constituting the natural frontier of Portugal — so far as the boundary between the two nations can be regarded as natural, and not purely conventional.

In spite of the fact that it appears on first view to be characterized by exceptional unity in form and contours, Spain offers in the interior a great variety of geographical conditions; since nature has divided it into isolated regions essentially differing in climate, the geological composition of the soils, the flora, the fauna, and the character, customs and worldly possessions of its inhabitants. As a consequence of the exceptionally diverse geographical conditions, there are also marked differences in the density of the population of the several districts. Thus, from the periphery to the centre the density of the population decreases in such a fashion that we can say the inhabitants are distributed in concentric zones of different density, the minimum, with the exception of the arbitrarily located capital, being at the centre, which is the part of Spain that nature favors least of all.

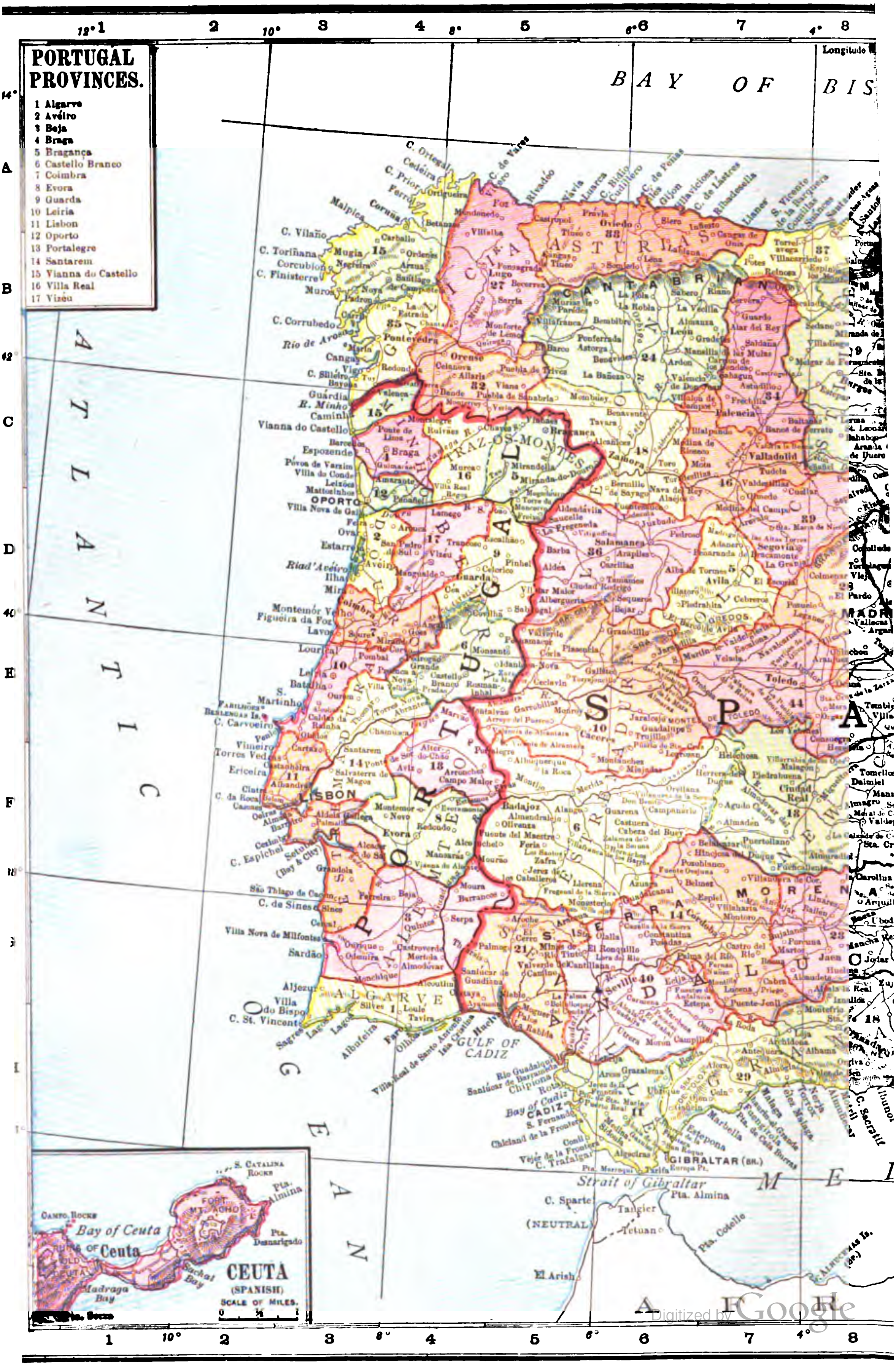
Geology.— Extending like a bond of union between Europe and Africa, the Iberian Peninsula makes the impression of being the least European of the three great Mediterranean peninsulas: it announces Africa by the massive character of its forms and by the existence of its mighty central meseta. «It is,» says an authoritative writer in the study by R. Douvillé, entitled 'La Péninsule Ibérique, on Espagne' (Heidelberg 1911), «a world apart, separated from Europe by the high Pyrenean barrier which cannot be surmounted easily except at the two extremities, separated from the Mediterranean world by the different coast ranges that now themselves form the shore and again leave only a narrow strip between themselves and the sea»— for example, the Valencian *huerta* and the plain of Tarragon. It is indeed possible to give correct ideas of the main structural characteristics of Spain, but, as the same geologist cautions, we possess only relatively few precise notions concerning the constitution of the zones of its mountain-folds, despite the fact that the stratigraphy of a large number of its natural regions is known in detail, and several of the regions have even become classics for the geological student. Thanks to the labors of Léon Bertrand and Bresson, of the Andalusian commission, of Nicklès and of R. Douvillé, we are beginning to know with some precision the structure of the two border chains, the Pyrenean and the Sub-bétic or Penibétic, the latter including the Sierra Nevada. The complexity of the corrugations of the ancient rocks of the Cantabrian chain has been brought to light by Barrois, but as to all that relates to the inequalities of the central portion of the meseta, grouped together by Choffat under the name of the Lusitano-Castilian System, we are still left in uncertainty: their structure and exact age are wholly unknown. Moreover, the Bétic chain remains still unexplored, from the structural point of view.

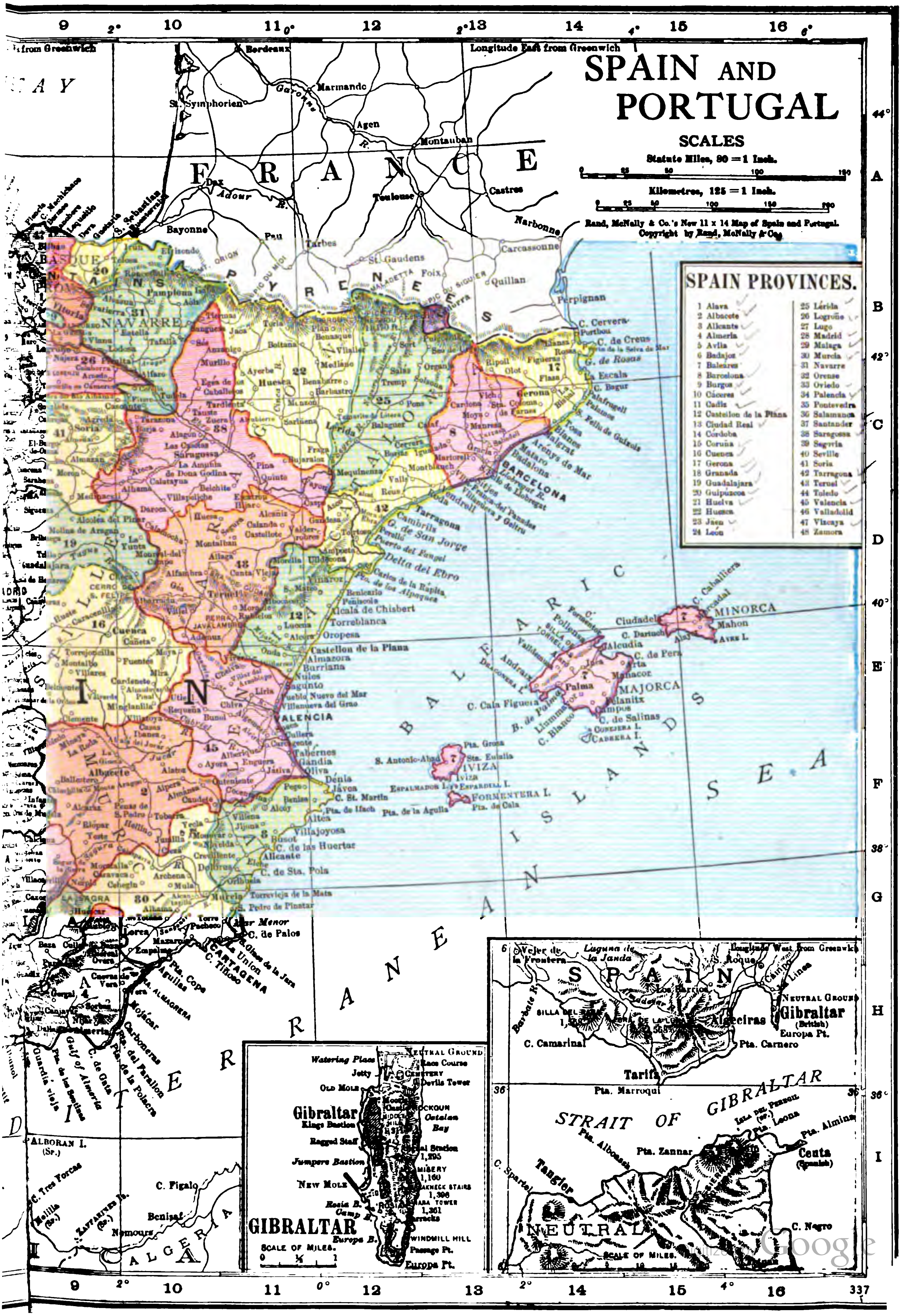
With due recognition of the limitations just indicated we present the following general and brief account, deduced from the facts actually known.

The orientation ot the outcropping strata in the centre and northwest is different from that in the regions of the Pyrenean, Catalonian and Bétic ranges. In the centre and northwest the outcropping strata — Silurian, for example — are aligned nearly southeast and northwest; in the Pyrenean Catalonian and Bétic chains, on the contrary, the outcroppings in the main follow the direction of the mountain ridges (chaînons) and are oriented approximately southeast by east and north-northwest or southwest and northeast. Thus we are dealing with systems of corrugations or folds that are essentially different. The southeast-northwest folds are those of the mighty crystalline and Paleozoïc mass of the Iberian meseta; the others are those of the bordering chains, the Pyrenean, Catalonian and Bétic. These bordering chains have a nucelus formed, like the meseta, of Crystalline and Paleozoïc rocks, but in addition they possess representatives of almost entire sedimentary series. They belong to the zone of Alpine folds; they have had a geologic history extremely different from that of the meseta; and they also differ among themselves, one from the other, the Pyrenean and Catalonian chains showing distinctly special formations while the Bétic chain shows types that are general and seen in the whole Mediterranean zone. The Catalonian chain strongly resembles in almost all respects the Pyrenean; but it probably formed a part, in some former epoch, of a mighty crystalline mass occupying a portion of the Mediterranean until submerged at an indeterminate period. Similarly, the Bétic chain appears to have been partially submerged at the time of those Pliocene movements which accompanied the opening of the Strait of Gibraltar. The meseta is bordered on the south and on the north by two great transverse inequalities, of which the most striking is the fault of the Guadalquivir, at present underlined by the depression in which flows the Guadalquivir River: a gigantic fracture that cut, as with a knife, all the outcropping strata. A happening probably of the same kind was associated with the profound depression of the Ebro Valley. But the mesozoïc deposits which, at different epochs, have overspread the meseta, now hide all the northeast part of the Guadalquivir fault and the fracture of the value of the Ebro. These deposits are found to be more horizontal as one proceeds farther toward the interior of the peninsula. On the borders of the meseta they are slightly corrugated and form the Sierra del Moncayo and the Montes Universales which mark out the northeast border. The Sierra Morena has no geologic individuality. The depressions of the Guadalquivir and of the Ebro have been filled with Tertiary sediments; and the same holds true of the lowest portions of the meseta, the two Castiles. In consequence of a general uplifting movement throughout the meseta, with reference to the level of the sea, the Tertiary sediments upon the meseta have been raised until they form now the high plateaux already described.

Rivers.— The northern slope extends between the Bay of Biscay and the Cantabrian Mountains. Here we find a long and narrow zone characterized by heavy rainfall upon extremely steep declivities — with the result that its rivers are torrents, without value for navigation. The eastern slope is divided into three parts, namely, the slope of the eastern Pyrenees, the Ebro Valley and the southeastern region. In the first part we find the Muga, Llobregat, Ter, Tordera, Gallá and Francolí. In the second part, which embraces almost one-sixth of the area of Spain, we find the Ebro and its affluents, the Zadorra, Ega, Aragón, Gállego, Segre, Cinca, Jalón, Calatayud, Huerva and Guadalupe. In the third part are the Júcar, Vinalopó and Segura. The Ebro, if we may judge from data supplied by history, was formerly navigable from its mouth even to Logroño; but it has suffered important changes, and canalization at two points became necessary. The Carlos Canal was cut through the delta formed by deposits of sand and projecting out into the Mediterranean; the Imperial Canal was constructed from a point 40 miles below Zaragoza (Saragossa) to Tudela. The western slope is, from the hydrographic point of view, most important of all, since in this wide zone are found the valleys of the great rivers Miño, Duero, Tajo (Tagus), Guadiana and Guadalquivir. The last-mentioned has always been of highest value for transportation; and in early historical times it was navigable far beyond Seville — even to Córdoba or Montoro. The southern slope is even narrower than the northern, and is the least important of all in a hydrographic sense; the rivers of this slope being characterized by short course and small volume. Here we find emptying into the Mediterranean, the Almería, Adra, Guadalfeo, Guadalhorce, Guadiaro; and, emptying into the Atlantic, the Guadalete. With a few important exceptions, then, all the rivers of Spain dash, rather than flow, along precipitous beds among deflecting mountains; their character is torrential, their courses sinuous. Consult Becker, J., 'El Medio Geográfico en la Historia de España' (*Boletín de la Real Sociedad Geográfico,* Tomo LVIII, Madrid 1916).

Mountains.— The study of Spanish orography concerns itself with the three exterior lines that mark the northern, eastern and southern slopes, and the other three that extend through the interior. The northern system, including the Cantabrian Cordillera and the Pyrenees, bounds on the north the central meseta and the Ebro Valley. According to the classification of the Geographical Institute of Madrid, this is followed by (2) the Iberian system, formed by mountain-masses which separate the central meseta from the Ebro Valley [on the northeast] and from the Mediterranean slopes; (3) the Central system, generally known as Cordillera Carpeto-Vetonica or Carpetana, which extends through


PORTUGAL PROVINCES.
1 Algarve
2 Avéiro
3 Beja
4 Braga
5 Bragança
6 Castello Branco
7 Coimbra
8 Evora
9 Guarda
10 Leiria
11 Lisbon
12 Oporto
13 Portalegre
14 Santarem
15 Vianna do Castello
16 Villa Real
17 Vizéu
BAY OF BIS
ATLANTIC OCEAN
PORTUGAL
SPAIN
GALICIA
ASTURIAS
CANTABRIAN
TRAZ-OS-MONTES
MINHO
BEIRA
ESTREMADURA
ALEMTEJO
ALGARVE
LEON
OLD CASTILE
NEW CASTILE
ANDALUSIA
SIERRA MORENA
GULF OF CADIZ
Strait of Gibraltar
GIBRALTAR (BR.)
AFRICA
MEDITERRANEAN
Lisbon
Oporto
Coimbra
Braga
Evora
Madrid
Toledo
Salamanca
Valladolid
Seville
Cadiz
Tangier
Tetuan
C. Finisterre
C. Ortegal
C. St. Vincent
C. Trafalgar
Ceuta
CEUTA (SPANISH)
Bay of Ceuta
S. Catalina Rocks
Pta. Almina
Pta. Desnarigado
Madraga Bay
Sochat Bay
Campo Rocks
SCALE OF MILES.
Longitude
12° 10° 8° 6° 4°
14° 42° 40° 38°
1 2 3 4 5 6 7 8
A B C D E F


SPAIN AND PORTUGAL
SCALES
Statute Miles, 80 = 1 Inch.
Kilometres, 125 = 1 Inch.
Rand, McNally & Co.'s New 11 x 14 Map of Spain and Portugal.
Copyright by Rand, McNally & Co.
SPAIN PROVINCES.
1 Alava
2 Albacete
3 Alicante
4 Almeria
5 Avila
6 Badajoz
7 Baleares
8 Barcelona
9 Burgos
10 Cáceres
11 Cadiz
12 Castellon de la Plana
13 Ciudad Real
14 Córdoba
15 Coruña
16 Cuenca
17 Gerona
18 Granada
19 Guadalajara
20 Guipúzcoa
21 Huelva
22 Huesca
23 Jaén
24 Leon
25 Lérida
26 Logroño
27 Lugo
28 Madrid
29 Malaga
30 Murcia
31 Navarre
32 Orense
33 Oviedo
34 Palencia
35 Pontevedra
36 Salamanca
37 Santander
38 Saragossa
39 Segovia
40 Seville
41 Soria
42 Tarragona
43 Teruel
44 Toledo
45 Valencia
46 Valladolid
47 Vizcaya
48 Zamora
Longitude East from Greenwich
FRANCE
PYRENEES
BALEARIC ISLANDS
MEDITERRANEAN SEA
MAJORCA
MINORCA
IVIZA
FORMENTERA I.
BARCELONA
VALENCIA
CARTAGENA
ALGERIA
ALBORAN I. (Sr.)
GIBRALTAR
SCALE OF MILES
STRAIT OF GIBRALTAR
Gibraltar (British)
Ceuta (Spanish)
Tangier
NEUTRAL GROUND

the centre of the peninsula and separates the mesetas of the two Castiles; (4) The system of the mountains of Toledo, extending east and west in the centre of the meseta of New Castile; (5) the Bétic Cordillera, between the great central meseta and the depression of the Guadalquivir and formed mainly by the Sierra Morena; (6) the Penibétic system, which extends from Cape Tarifa to the Sierra Nevada, including both, and shuts in the valley of the Bétis, or Guadalquivir, on the south.

Climate.— Extending approximately from lat. 36° N. to little less than 44° N., Spain forms a part of the southern region of the temperate zone, and would be endowed with a climate characterized by very distinctly marked seasons were such cosmic traits not greatly modified by various circumstances. We have already mentioned, among the geographical influences to which its climate is subject, the great heights and different orientation of its cordilleras and the varied configuration of its lands — such diversity of natural features of course affecting the atmospheric circulation and in part explaining sudden alternations of winds that are hot and damp with those that are cold and dry. But we must also remember that the north coasts, influenced by the Bay of Biscay, the western by the Atlantic Ocean, the southern and eastern by the Mediterranean Sea, experience particular effects which are far from being the same. Moreover, the influence of the Gulf Stream is felt especially on the northwest coast, and that of the Sahara in the south. It is, therefore, proper to emphasize Spain's climatological diversity: it is not possible to say that a well-defined climate prevails in or throughout any extensive region whatever, since there exist in the country, and sometimes almost side by side, all the mixtures from subtropical to Alpine. On the plains of New Castile and Estremadura, as in a large part of Andalusia, the climate in summer is rather fiercely torrid; in all the cordilleras one finds delicious valleys, of benign temperature; but the lands of Old Castile and León are characterized by harsh and prolonged winters. The annual rainfall, greatest in the northwest, especially Santiago, is slightly less at Saint Sebastian and Bilbao; about half as great at Coruña, San Fernando, Cáceres and Jaén; less than one-half as great at Málaga, Soria, Burgos, Huesca, Segovia and Barcelona; about one-third, or even less, at Sevilla, Murcia, Valencia, Granada, Alicante, Molina and Madrid; about one-fourth at León, Badajoz, Lérida, Cartagena and Valladolid; and at Salamanca and Zaragoza the annual rainfall amounts only to one-fifth or one-sixth of that which makes the Spanish northwest a beautiful green country.

Flora.— The diversities of temperature, etc., to which we have invited attention (see CLIMATE) occasion such a variety in the species of vegetation as no other country of Europe presents. For this reason Linnæus bestowed the title «India of Europe» upon Spain — which, indeed, in all historical ages has been considered the botanist's land of promise although the growths ot forest and field are checked by the extreme aridity of the meseta. The number of indigenous species positively known to exist in Spain exceeds to-day 7,100, without counting those varieties and forms about which doubt is still entertained. This wealth becomes even more manifest on comparing it with that of other countries. Thus, if we reckon at 10,000 the number of species of vascular plants in Europe as a whole, about 5,400 of them exist in Spain, 4,225 in France, about 5,000 in Italy, including Sicily, and slightly more than 1,600 in England. Even in the small province of Madrid there are, despite the aridity of its plains, approximately 2,000 species. And if we compare the numbers of the *exclusive* species we shall find that 1,200 endemic species exist in Spain (about 22 per cent of the vasculars); in Italy about 300 or about 6 per cent of its flora). In France the strictly indigenous species number about 100 (or, say, somewhat more than 2 per cent). We may estimate very closely the affinity of the Spanish flora with that of other lands as follows: Of spontaneous vascular species in Spain 60 per cent are represented also in the other European floras; 25 per cent are very similar to those of northern Africa; slightly more than 13 per cent Spain possesses in common with Asia; with South America not more than 7½ per cent; with North America less than 3 per cent; 2½ per cent with tropical and southern Africa; and with Oceania only about five species per mille.

Fauna.— Like that of all the rest of the Palæarctic-Mediterranean subzone, the fauna of Spain is extensive and extremely varied. A leading work on the crustaceans entitled 'Materials para la Fauna Carcinologica de España,' by Sr. Odón de Buen, says that the Mediterranean region is richer than the «Celtic» [northern and northwestern] in the carcinological fauna. D. Francisco García Solá, in his *Memoria* prepared for the Central Commission of Fisheries of the Navy Department, calls attention to the circumstance that the waters of the east and south coasts contain many varieties of fish for the reason that the Mediterranean is «the great natural breeding-place of the Atlantic and perhaps of other more remote seas.» The number of specific forms or species of insects in the entire peninsula is reckoned at more than 160,000. The most common reptiles are *Vipera latastei, Tropidonotus viperinus, Rhinechis scalaris, Psammodromus hispanicus* and *Lacerta muralis*. The avifauna includes particularly some arctic species in the high mountains, great numbers of maritime and river-birds, and (in the southeast) several species of vultures and falcons. Mammals are uncommonly well represented, in the Perisodactyl order, by the genus *Equus*, and by ruminants of the Artiodactyl order. The order of Carnivora is represented by the *Ursus arctos*, by Spanish varieties of the genus *Canis*, the *Canis lupus*, the *Canis vulpes*, etc.

Forestry.— The mountains and many tracts of the table-land are in general very scantily supplied with trees and a want of timber, both for fuel and economical purposes, is severely felt in many quarters. The finest forests are on the western offsets of the Pyrenees and in the mountains of Asturias. The more remarkable trees are the Spanish chestnut and several varieties of oak, and in particular the cork-oak.

Fisheries.— This industry employs 15,512 boats, of which 791 are steamers, and 88,150 fishermen. The catch in a recent year aggregated 148,978 tons valued at $18,166,650. Cod, sardines and tunny fish are the most important catches. Sardines and fish-preserves are prepared in 677 factories employing 19,320 workmen and having an annual product valued at $12,634,878.

Agriculture.— It is remarkable that Spain, though one of the most naturally productive, is also one of the least cultivated of the countries of Europe. More than a third of the land capable of profitable cultivation is allowed to lie waste, and the system of agriculture pursued is far behind that of any other European country. The finest agricultural district is Valencia, where both rice and corn are grown far beyond the wants of the actual population, and furnish large supplies to those parts of the interior which are less favorably situated. After Valencia, Catalonia, Murcia, and some of the northern provinces, raise the largest quantities of grain. The more important crops are wheat, rice, maize, barley and legumes. The culture of the vine is general, and great quantities of wine are made, both for home consumption and exportation. The demand for the latter is chiefly confined to sherry and the sweet wines of Malaga and Alicante. A considerable part of the grapes grown are dried and exported in this state, especially from the port of Malaga. Nuts, common and pistachio, walnuts and chestnuts grow in such abundance as to form important articles of trade. In the warmer districts the olive, sugarcane and cotton-plant are partially cultivated. Fruits are extremely abundant and include in addition to apples, pears, cherries, plums, peaches and apricots, the almond, date, fig, orange, citron and pomegranate; and in the lower districts of the south, the pineapple and banana. Hemp and flax are extensively grown in Aragon, and Galicia, and esparto grows in abundance, more especially in Valencia and Murcia, where it is in extensive demand for making ropes, mats, baskets, etc., besides being exported. The mulberry thrives well, and is largely cultivated for rearing silkworms in Valencia, Murcia and Granada. Other vegetable products are saffron, licorice and barilla. Much of the higher part of the central tableland, however, presents a very sterile appearance, having a thin stony soil and a covering of heath and scanty pasture; still extensive tracts which might be advantageously cultivated are left almost in a state of nature, to be roamed over by cattle, sheep, goats and swine.

Of Spanish soil 88.45 per cent is classed as productive; of this 35.5 per cent is devoted to agriculture and horticulture, 2.5 to vineyards, 2.9 to olives, 22.2 to fruits and 25.3 to native grasses. There are 3,426,083 separate holdings which pay a property tax. The acreage and yield of the chief crops in 1918 was: wheat, 10,348,537 acres, yield 73,868,578 cwts.; barley, 4,258,892 acres; 39,406,852 cwts.; oats, 1,524,453 acres, 8,846,606 cwts.; rye, 1,839,752 acres, 15,466,774 cwts.; maize, 1,182,742 acres, 12,264,502 cwts.; rice, 111,807 acres, 4,152,968 cwts.; beans, 498,385 acres, 4,012,110 cwts.; kidney beans, 794,607 acres, 3,622,040 cwts.; peas, 138,607 acres, 645,356 cwts ; chick peas, 562,267 acres, 2,334,548 cwts.; tares, 457,165 acres, 1,748,414 cwts.; vetches, 159,472 acres, 996,522 cwts.

In the same year 3,292,925 acres were under vines. The production was 8,400,104,240 pounds of grapes, yielding ordinary red and white wines to the extent of 496,487,596 gallons. About 3,760,000 acres were under olives and yielded 1,986,930 tons of olives and 385,053 tons of oil. The recent live-stock census showed 557,676 horses; 1,042,894 mules; 923,996 asses; 3,233,200 cows; 17,227,019 sheep; 4,181,942 goats; 3,929,449 pigs and 5,400 camels (Canary Islands).

Stock Raising.—Among domestic animals the horse, descended from breeds which the Moors had introduced, was long celebrated throughout Europe, but has in recent times declined in reputation, though Andalusia still boasts of many fine animals. The mule is generally preferred to the horse, both for carriage and draft, and is extensively reared in New Castile. Both it and the ass are generally of a very superior description. Horned cattle are generally inferior and not numerous; only in a few districts are cows kept for dairy purposes; bulls, in great demand for the national amusement of bull-fights, are reared in greatest perfection in Andalusia. The favorite stock is the sheep, a considerable proportion of which belongs to the celebrated Merino breed, to which almost all the other breeds of Europe are more or less indebted for improvement. Goats also are very numerous, and in their flesh, milk and cheese furnish the favorite food of the inhabitants. Swine are kept in large herds in some parts of Estremadura and in some of the northern provinces, where they roam at large in the forests. See AGRICULTURE section.

Manufactures, Mining, Commerce, etc.—In the Middle Ages the manufactures of Spain, particularly along the coasts of the Mediterranean, were in a flourishing condition and found an extensive demand, particularly in the Levant and other parts of the East. With the expulsion of the Moors the branches which they had specially fostered sunk rapidly into decay and have never been revived. New demands, however, arose in the West and Spain, as the mother country, reserving to herself the sole supply of the colonies, was able, for that purpose alone, to carry on a number of lucrative manufactures. The loss of these colonies, putting a sudden stop to the demand, was followed by their almost as sudden extinction. The circumstances of the country since have been the most unfavorable that can be conceived to the progress of any branch of regular industry and hence the only manufactures of any importance are to be found in a few of the larger towns, especially Barcelona. Spain is comparatively rich in minerals. Iron is plentiful in Huelva, Navarre, Oviedo, Santander, Seville and Vizcaya; copper in Córdoba, Huelva and Seville; coal in Córdoba, Geronas, Leon, Oviedo and Valencia; zinc in Guipúzcoa, Murcia, Santander and Vizcaya; cobalt in Oviedo; lead in Almería Jaen and Murcia; manganese in Huelva, Oviedo and Seville; quicksilver in Ciudad Real and Oviedo; silver in Guadalajara; soda in Burgos and phosphorus in Cáceres and Huelva. Platinum has also been found in small quantities. A recent industrial census showed 127,556 men, 3,917 women and 20,273 boys and girls under 18 employed in connection with the mining industries. In 1917 the total value of the mineral output was $97,692,858, made up as follows:

MINERAL	Quantity produced in metric tons	Value
Anthracite	324,756	$2,473,373
Asphalt	1,817	4,274
Mercury	18,706	701,064
Sulphur	84,979	1,580,921
Zinc	123,486	1,830,286
Copper	1,901,340	12,295,912
Tin	77	21,160
Phosphorite	28,148	137,019
Iron	5,551,071	7,925,115
Iron pyrites	376,918	3,898,320
Coal	5,042,213	48,097,335
Lignite	637,841	4,690,024
Manganese	54,474	419,824
Silver	96	15,654
Lead	240,368	12,305,766
Argentiferous lead	13,218	6,592
Salt	309,413	368,172
Wolfram	546	328,856

There are large manufactures of cottons, Catalonia being the principal centre of this industry. There were reported at the last industrial census, 742 establishments employing 68,300 looms and with 2,614,500 spindles. The woolen industry occupies 8,800 looms and 662,000 spindles. There are 144 paper mills and 37 glass-making factories. Corks are also an important product. In a recent year 51,089 tons were manufactured having a value of about $9,000,000.

Imports in 1918 were valued at $121,970,385 and the exports $189,585,420. In that year the chief classes of imports and exports were as follows:

CLASS	1918	
	Imports	Exports
Stone, glassware, pottery	$5,799,220	$15,042,840
Minerals, metals and metal goods	3,998,330	29,692,450
Drugs and chemicals	7,236,800	12,262,950
Cotton and cotton manufactures	20,506,420	23,577,800
Other vegetable fibres, etc	3,506,220	1,909,715
Wool, hair, and their manufactures	6,327,680	17,923,785
Silk and silk manufactures	5,210,655	1,401,495
Paper and paper goods	1,704,640	2,984,515
Timber and timber products	2,668,915	7,102,220
Animals, animal products	9,934,560	7,302,710
Machinery, vehicles, etc.	11,888,390	4,103,145
Food stuffs, including grains, sugar, wine, etc.	25,619,315	66,656,980
Miscellaneous	3,788,025	2,721,200
Gold (bar and coin)	6,771,740	40,310
Silver	57,040	1,863,305
Tobacco (special)	6,795,310	....
Packing	157,125	....
	$121,970,385	$189,585,420

The value of all wine exported in 1918 was $18,625,685. In 1917 the United States was the leading country importing goods into Spain with a total value of $155,339,800. In the same year France took more Spanish goods ($117,653,600) than any other country. The United Kingdom was second with $40,413,000 and the United States third with $21,225,600. Cuba, Porto Rico and the Philippines also ($117,653,600) than any other country. The customs receipts and post dues amounted to $23,935,235 in 1918.

Art.— See SPANISH ART.

Language and Literature.— See SPANISH LANGUAGE; SPANISH LITERATURE.

Spanish Educational System.— The present Spanish school system dates from 1900. The centres of education are divided into three categories: primary, secondary, or preparatory, and superior, or university. The first is supplied by the municipalities or by licensed private schools; the second is directly controlled by the state and consists of institutes and private colleges under governmental supervision. The instruction in the preparatory schools consists of two sections, arts and sciences, and the baccalaureate is given in these institutions and not in the universities. The third class is made up of the universities, all supported by the state. In the larger cities, moreover, are normal colleges, commercial and language schools and institutions for the primary instruction of adults. The system is well planned and based on good laws but the lack of finances makes even the number of primary schools inadequate in small towns and rural districts. The whole system is under control of the Minister of Public Instruction and Fine Arts.

Spain is divided into 11 university districts with uniform organization, which are in order of rank: Madrid, Barcelona, Granada, Oviedo, Salamanca, Santiago, Seville, Valencia, Valladolid, Murcia and Saragossa. The largest is Madrid with more than 6,500 students. At the head of each university is a president who has charge not only of the institution proper, but of all the schools in his district. The faculties are presided over by deans subordinate to the president. Professors obtain their chairs in competitive examinations held publicly when a vacancy occurs. Besides the 10 universities maintained by the state are three controlled by religious orders; but they are not officially recognized and to obtain credit for his work in these institutions a student has to pass the prescribed examinations in the state universities. In the near future the government is to establish another university in the Canary Islands, now a province of Spain.

The government institutes or preparatory schools are grouped in 10 sections corresponding to the 10 universities of the state and are further subdivided into provincial or local institutes according to their importance.

University instruction embraces the five faculties of philosophy and letters, sciences, law, medicine and pharmacy, all of which include several subdivisions. Theology is not now taught in the universities although members of the clergy and religious orders often hold important chairs in them. All five faculties exist and the doctorate is conferred only in the Central University of Madrid. Modern languages are not taught in the universities but in certain special schools. French is taught in the institutes.

To obtain the doctorate in medicine seven years' study are necessary; this is the longest course. The degree of licentiate is conferred after six years' study in law, five in pharmacy and four in the other faculties. The doctorate and the licentiate are given in all faculties. These two are the only university degrees. The former is similar to that given in American universities, while the latter is an intermediate stage between the American degree of bachelor and master. The student must needs have attained the age of 16 and received the baccalaureate in arts or sciences before permitted to enter the universities as a candidate for a degree. The students are divided into two classes: official or free (*oficial o libre*). The official students must attend classes and stand examinations, somewhat less rigorous than those given to the students of the latter class, who do not attend classes and matriculate only for the examinations at the end of the year. The examinations are both oral and written and a second series have to be passed when the student applies for his degree. This division of the students into official and free also applies to the institutes of the state. A student may be official or free at his option, or he may be a free student in some subjects and official in others, or free in all subjects and attend the class lectures with the permission of the professor in charge. This arrangement exists for the convenience of the student who receives his instruction from a tutor or who attends an institution conducted by the Church. No distinction is made between the sexes in governmental schools and women have never been refused admittance to the universities. The number of women taking university courses, however, is negligible and in 1914 there were only some 25 in the University of Madrid.

Certificates signed by the examining board of three professors are given to the student for each subject he passes; the three passing grades are «approved,» «honorable mention» and «excellent,» and the certificates are marked accordingly. A student who receives «excellent» (sobresaliente) in his subjects is entitled to the remission of part of his fees for the following academic year. All students, official and free, pay about 35 pesetas ($6.65) for each subject in which they are examined. Students particularly successful in their university work are sometimes. but not always, granted government grants for study abroad. According to a royal decree of 19 Sept. 1913 «titles which in their respective countries give the holder entrance without examination into the universities will be valid in Spain.» Owing to Spain's refusal hitherto to recognize foreign degrees, many thousands of students from Latin America are studying in other lands. Since 1902 the Spanish government has sent scholars, teachers and professors to foreign countries to study. Since 1910 there has existed a Board of Scientific Research (*Junta para ampliación de estudios*), which connects the work done abroad with the organization of new laboratories in Spain, and publishes works showing the results obtained. This board has started the foundation of Halls of Residence for students where an important educational and a certain amount of scientific work is done. This board expends about 800,000 pesetas ($154-000) per annum. A Hall of Residence for women students was opened in Madrid in 1916.

The government spends about $8,000,000 annually on its primary school system. There are 26,108 public and 5,669 private schools, the total number of pupils being 2,604,308. There are 58 institutes or middle-grade schools with 52,015 pupils. The 11 universities are attended by 32,683 students. The educational system and fine arts departments cost the government $15,000,000 in 1918.

Religion.— The state religion is Roman Catholic. The Church is governed by 9 archbishops and 47 bishops, but two of the former and five of the latter have their dioceses beyond sea. The number of parishes is about 20,498. In 1837 all the convents of monks, with a few exceptions, were suppressed and their revenues, subject to a provision for existing members, confiscated to the state. At the period of extinction the number of convents was 1,940, with 30,906 monks; there are still 790 convents with 9,339 monks and 3,010 with 39,709 nuns. Since the last revolution toleration of all denominations has been decreed. The whole population of Spain is Roman Catholic, except about 30,000 of whom 7,000 are Protestants and 4,000 Jews, Rationalists, etc. The State supports the clergy of whom there are over 35,000. About $8,000,000 are expended annually for this purpose. Relations between Church and State are regulated by the Concordat of 1851.

Army and Navy.— Military service is compulsory. The total term of service extends over 18 years. According to the law enacted in 1912 this period is divided into: one year, *Reclutas en Caja* (recruits in deposit); three years, active army (first standing); five years, active army (second standing); six years, reserve; and three years, territorial reserve. A general army staff was created in January 1916. For army administrative purpose, Spain is divided into eight territorial districts, each under a captain-general. District one to six inclusive each furnish two divisions, the districts seven and eight, one division. A division comprises two infantry brigades, each consisting of two regiments of three battalions, one regiment of cavalry, and one regiment of field artillery of six batteries. Batteries have four guns. The peace establishment of the army was fixed at 190,228 men of all ranks for 1918. In addition to the organization outlined above, which would develop a war strength of about 1,400,000, there are the Guardia Civil and the Carabineros. The former is a police force, and the latter a species of coast guard or revenue police. The Guardia has a strength of 18,000 infantry and 2,500 cavalry; the Carabineros 13,000 infantry and about 500 cavalry. Outside of Spain there are three military districts — Morocco, the Balearic Islands and the Canaries. In the two last-named the forces are recruited from the islanders but in Morocco the troops are Spanish and are always on a war footing. The African (Morocco) establishment totals about 70,000 men. The Mauser 275, model of 1893 is the infantry arm. Schneider Canet 14½ pr. of 19.106 that of the field artillery.

There is a military aviation school at Cuatro Vientos, near Madrid. There are military wireless stations at Carabanchel (range 540 miles), Barcelona (430 miles), Melilla, Centa, Tetuan, Bilbao, Valencia (of 320 miles each), Almeria, Larache (220 miles each), Mahon (Baleares) and Coruña. The military budget for 1918 aggregated $53,000,000, of which about $20,000,000 was for the Moroccan establishment.

The old navy was about totally destroyed or captured in the war with the United States, but in recent years naval construction has somewhat reinstated Spain in her old position. The navy at present has three dreadnoughts of 15,460 tons displacement each and are armed with eight 12-inch, 20 4-inch and six smaller rifles, also two torpedo tubes. The horsepower of each vessel is 15,500 and the speed 19½ knots per hour. There is also one old battleship, the Pelayo of 9,890 tons. There are seven cruisers, totaling 33,000 tons, also 13 destroyers and 24 modern torpedo boats, and a few gunboats. In 1915 a new construction program was inaugurated calling for four cruisers, six destroyers, 28 submarines, three gunboats, 18 coast-defense vessels, submarine mines, repair docks, etc., at a cost of $55,000,000 to be completed in six years. Spain has 10 submarines. The strength of the navy in 1918 was fixed at 11,091 sailors, 4,190 marines and 1,662 officers.

Money, Weights and Measures.— By a decree of the Cortes in 1868 a new monetary system was introduced into Spain, according to which accounts are kept in *centesimos* and *pesetas:* 100 centimos = 1 peseta = $0.19; or one franc. The gold coins are pieces of 100, 50, 25, 20, 10 and 5 pesetas; the silver coins are pieces of 5, 2, 1 pesetas and 50 centesimos. The bronze coins are pieces of 10, 5, 2 and 1 centimos. The weights and measures are precisely the same as those of France, with no other change than a slight one of names, the *metre* becoming the *metro*, the *litre* the *litro* and so on. The old system is still in use in many places. Its chief weights are the *Quintal* = 220.4 pounds; the *libra* = 1.014 pounds; liquid measures are the *arroba* = 3½ gallons for wine and 2¾ gallons for oil; the square *vara* = 1.09 vara = 1 yard; dry measure, the *fanega* = 1½ imperial bushels.

Communications and Shipping.— Trade labors under great disadvantages from the want of proper means of communication. The roads, except the royal roads (*caminos reales*), are generally wretched; the rivers, though numerous, are ill fitted for navigation; and though in recent times much has been done in constructing railways and tramways, much more is still required. Hence the foreign trade is almost necessarily confined to such articles of raw produce as are raised in greatest abundance and can be most easily conveyed to a seaport. The length of railways in Spain is 8,993 miles (14,988 kilometres), of which 6,880 miles are of 5.48 foot gauge (1.67 metres) and 2,106 miles of varying gauges, but mostly of 3.28 foot gauge. About seven miles are cogwheel and funicular lines. About 71,000,000 passengers were carried in 1917 and 35,500,000 tons of merchandise. All roads are in the hands of private companies, but nearly all are subsidized by the government. The receipts of the Post-Office Department in 1916 were $7,599,760 and the expenses $3,910,655. In that year it handled 190,733,150 letters and post-cards and 280,351,621 printed papers, samples, etc. There are 6,792 post-offices. Spain has 64,832 miles of telegraphs, which in 1916 carried 16,705,945 messages. The system has 2,435 offices. There are 141 urban telephone systems and 202 interurban circuits, with a total of 48,410 telephone stations. There are 10 wireless stations controlled by a single company.

The Spanish merchant marine consists of 495 steam vessels of 749,548 tons net and 85 sailing vessels of 31,209 tons net. In 1918 there entered with cargoes at Spanish ports 5,857 vessels of 5,060,937 tons and 6,618 vessels in ballast of 3,684,747 tons. In the same year the total clearances were 13,836 vessels of 7,203,843 tons of which 12,595 vessels of 6,700,452 tons were with cargoes. Of the vessels entered 9,699 of 5,607,185 tons were Spanish; of the clearances 11,120 of 4,093,436 tons were of Spanish registry.

Government.— Up to 1868 the government of Spain, which was that of a hereditary constitutional monarchy, was regulated by a constitution adopted in 1837, and subsequently modified in 1845. After the deposition of Isabella II a new constitution was drawn up by the Cortes, elected by universal suffrage. This constitution bore date 1 June 1869, and modified considerably the previous one. According to it, "all powers emanate from the nation. The power to make laws resides in the Cortes. The sovereign sanctions and promulgates the laws. The executive power resides in the sovereign, who exercises it by means of ministers. The tribunals exercise the judicial power." After the abdication of King Amadeo in February 1873, Spain changed its form of government to that of a federative republic, until the proclamation, as king, of Alfonso XII., 31 Dec. 1874, when the constitution of 1869 was again brought into force. A new constitution, however, was proclaimed in 1876, when certain amendments were introduced. According to the enactments at present in force Spain is governed constitutionally, the executive power residing in the king, the legislative in the king and Cortes (or parliament) conjointly. The Cortes consists of two independent bodies or bodies of equal authority, the Senate and the Congress. The members of the Senate form three classes, namely, senators in their own right, not to exceed 80 in number; life senators nominated by the crown, 100 in number; and elected senators, 180 in number. The senators in their own right include royal princes who have attained their majority; grandees of the kingdom who are in possession of an income of 60,000 pesetas or about $12,000; captains-general in the army, admirals of the navy; the archbishops, the patriarch of the Indies, the presidents of the council of state, the supreme tribunal and several other similar functionaries. The elective senators are chosen by the corporations of state, such as provincial legislatures, universities, the ecclesiastical bodies, etc., and the citizens who are the largest payers of state burdens, and this portion of the Senate is renewed by one-half every five years or altogether when the body is dissolved by the sovereign. The Congress or second legislative body, is to comprise at least one deputy to each 50,000 of the population. The Cortes must meet each year, and its sessions are to be convoked, suspended or closed by the king. No project can become law until after it has been voted in both bodies. Projects of finance or taxation must be presented to the Congress before being submitted to the Senate. Voting is compulsory for all males over the age of 25 with a few exceptions. All such voters must be registered on the voting list and must possess full civil rights. Members of Congress must be 25 years of age and are re-eligible indefinitely, the election being held quinquennially. There are 417 deputies. Neither senators nor deputies receive any compensation.

Local Government.— The various provinces and communes are governed by their own municipal laws with local administration. Every commune has its own elected *ayuntamiento*, consisting of from five to 50 *regidores* or *consejales* and presided over by the *alcalde*, who in the larger towns is assisted by several *Tenientes* Alcaldes. The entire municipal government, with power of taxation, is vested in the *Ayuntamientos*. Half the members are elected every two years and they appoint the *Alcalde* from their own body. Members cannot be re-elected until after two years. Each province has its *diputacio provincial* or parliament, whose members are elected by the ayuntamientos, and in which are vested large political powers. It meets annually, and is permanently represented by the *Comision provincial*, a committee of its members, appointed every year. Neither the national executive nor the Cortes have the right to interfere in the established municipal and provincial administration except in the case of the action of the *Diputaciones Provinciales* and *Ayuntamientos* going beyond the locally limited sphere to the injury of the general and permanent interest. Pressure is often brought to bear on local elections by the central government.

Finances.— The revenue, raised chiefly by direct and indirect taxation, stamp-duties, government monopolies, colonial revenue and income from state property, amounted in 1919 to 1,648,800,068 pesetas ($329,760,013) and the expenditure to 2,065,065,606 pesetas ($413,013,121). Of the latter the public debt absorbed $100,663,261, the Ministry of War, $87,232,469, the Ministry of the Interior, $44,000,000 and the Royal Household, $1,840,000. The National Debt of Spain on 1 Jan. 1919 was $1,884,317,207.

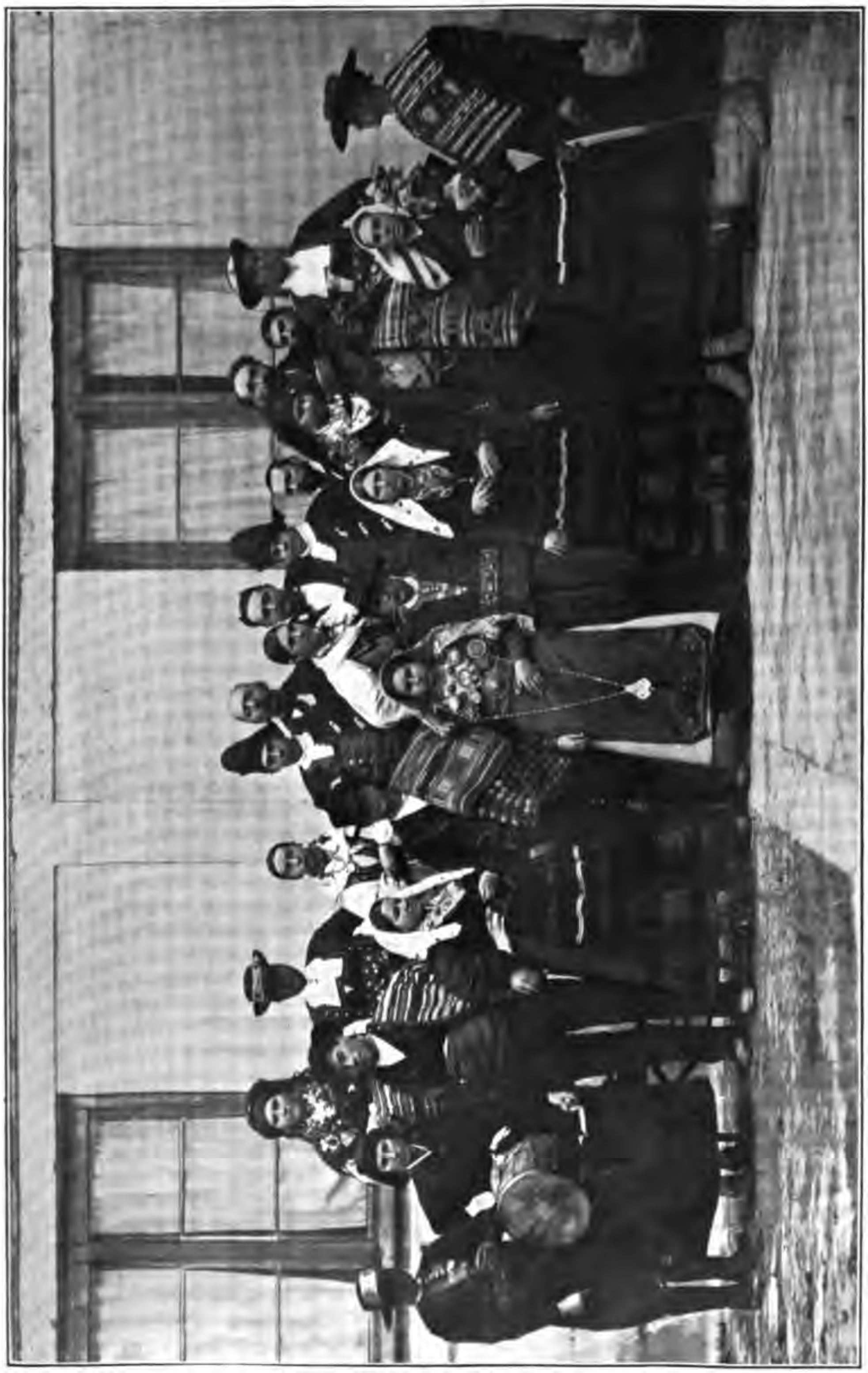
Population.— Formed by amalgamation of races or peoples as distinct as the Iberian, Celt, Phœnician, Greek, Carthaginian, Hebrew, Roman, Germano-Slav and Arabian, the population of Spain is endowed with characteristics which it is important to consider in connection with the development, or retardation of development, of the country; and that portion of the subject will, accordingly, be taken up in the section *History*. At present we note the total number of inhabitants (estimate in round numbers for 1917 about 20,376,000) and their distribution among the provinces, possessions and chief cities. The following table has been prepared with great care, but we think it impossible to achieve more than approximate accuracy in every item.

PROVINCES	Number of inhabitants	Area in square miles
Álava	98,000	1,175
Albacete	240,000	5,737
Alicante	500,000	2,185
Almería	385,000	3,360
Avila	212,000	3,047
Badajoz	620,000	8,451
Baleares	330,000	1,935
Barcelona	1,164,000	2,968
Burgos	350,000	5,480
Cáceres	416,000	7,667
Cádiz and Ceuta	476,000	2,834
Canarias	450,000	2,807
Castellón	323,000	2,495
Ciudad Real	400,000	7,620
Córdoba	506,000	5,299
Coruña	684,000	3,051
Cuenca	276,000	6,636
Gerona	326,000	2,264
Granada	534,000	4,928
Guadalajara	213,000	4,676
Guipúzcoa	237,000	728
Huelva	327,000	3,913
Huesca	249,000	5,848
Jaén	547,000	5,203
León	396,000	5,936
Lérida	289,000	4,690
Logroño	189,000	1,946
Lugo	483,000	3,814
Madrid	879,000	3,084
Malaga	529,000	2,812
Murcia	616,000	4,453
Navàrra	317,000	4,055
Orense	424,000	2,694
Oviedo	701,000	4,205
Palencia	197,000	3,256
Pontevedra	504,000	1,695
Salamanca	337,000	4,829
Santander	322,000	2,108
Segóvia	170,000	2,635
Sevilla	618,000	5,428
Sovia	158,000	3,983
Tarragona	338,000	2,505
Teruel	287,000	5,720
Toledo	427,000	5,919
Valencia	885,000	4,150
Valladolid	287,000	2,922
Vizcaya or Biscay	388,000	836
Zamora	275,000	4,097
Zaragoza	450,000	6,726
Possessions in the Gulf of Guinea	24,000	Uncertain
Possessions on north and northwest coast of Africa	23,000	
Totals	20,376,000	194,783

The cities with a population of more than 29,000 each were in 1917: Madrid, 600,000; Barcelona, 588,000; Valencia, 234,000; Sevilla, 159,000; Málaga, 137,000; Murcia, 126,000; Zaragoza, 112,000; Cartagena, 103,000; Bilbao, 94,000; Valladolid, 72,000; Lorca, 71,000; Palma, 68,000; Cádiz, 68,000; Córdoba, 67,000; Santander, 66,000; Santa Cruz (Canary Islands), 64,000; Las Palmas, 63,000; Jerez, 63,000; Alicante, 56,000; Jihon, 56,000; Oviedo, 54,000; San Sebastian, 50,000; Almeria, 49,000; Coruña, 48,000; Linares, 39,000; Badajoz, 36,000; Alcoy, 34,000; Vitoria, 33,000; Castellón, 33,000; Burgos, 32,000; Salamanca, 30,000; Pamplona, 30,000; Jaén, 30,000; Huelva, 30,000.

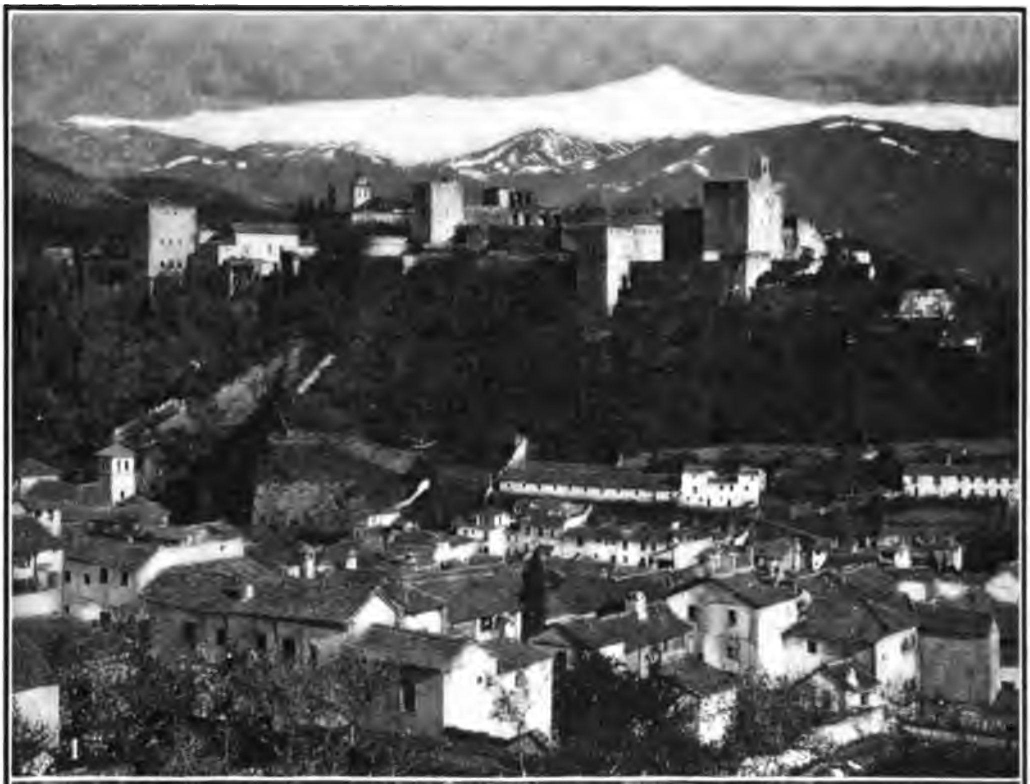
Ethnology.— The inhabitants of Spain consist chiefly of Spaniards proper, composed of a mixture of ancient aborigines, Romans, Visigoths, Vandals and Suevi; but partly also of three other distinct races — Basques, occupying the provinces to which they give their name and forming about $\frac{1}{24}$ of the whole population; Moors who, in the general expulsion of their countrymen, found refuge in several valleys in the kingdom of Granada and the Castiles, and whose descendants, unmingled with the other inhabitants, are still living there to the number of about 60,000; and Gitanos or gypsies,

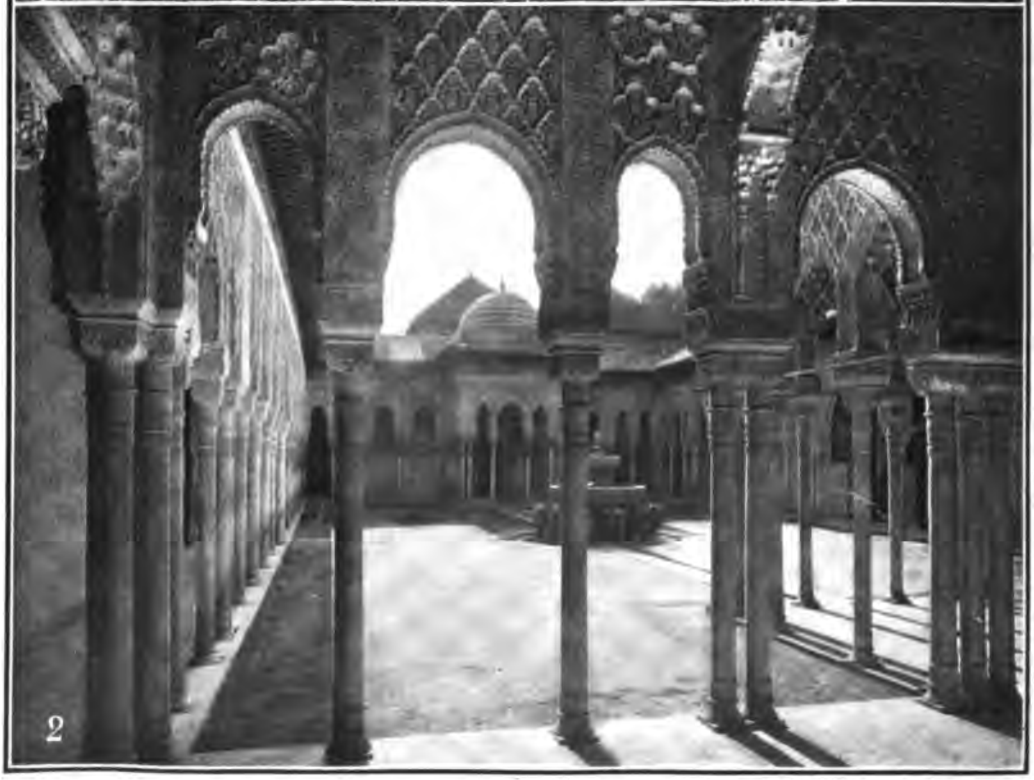
SPAIN



A group of peasants from the Province of Leon, in their Characteristic Costumes

SPAIN





1 View of the Alhambra and Sierra Nevada Mountains

2 Court of Lions, Alhambra

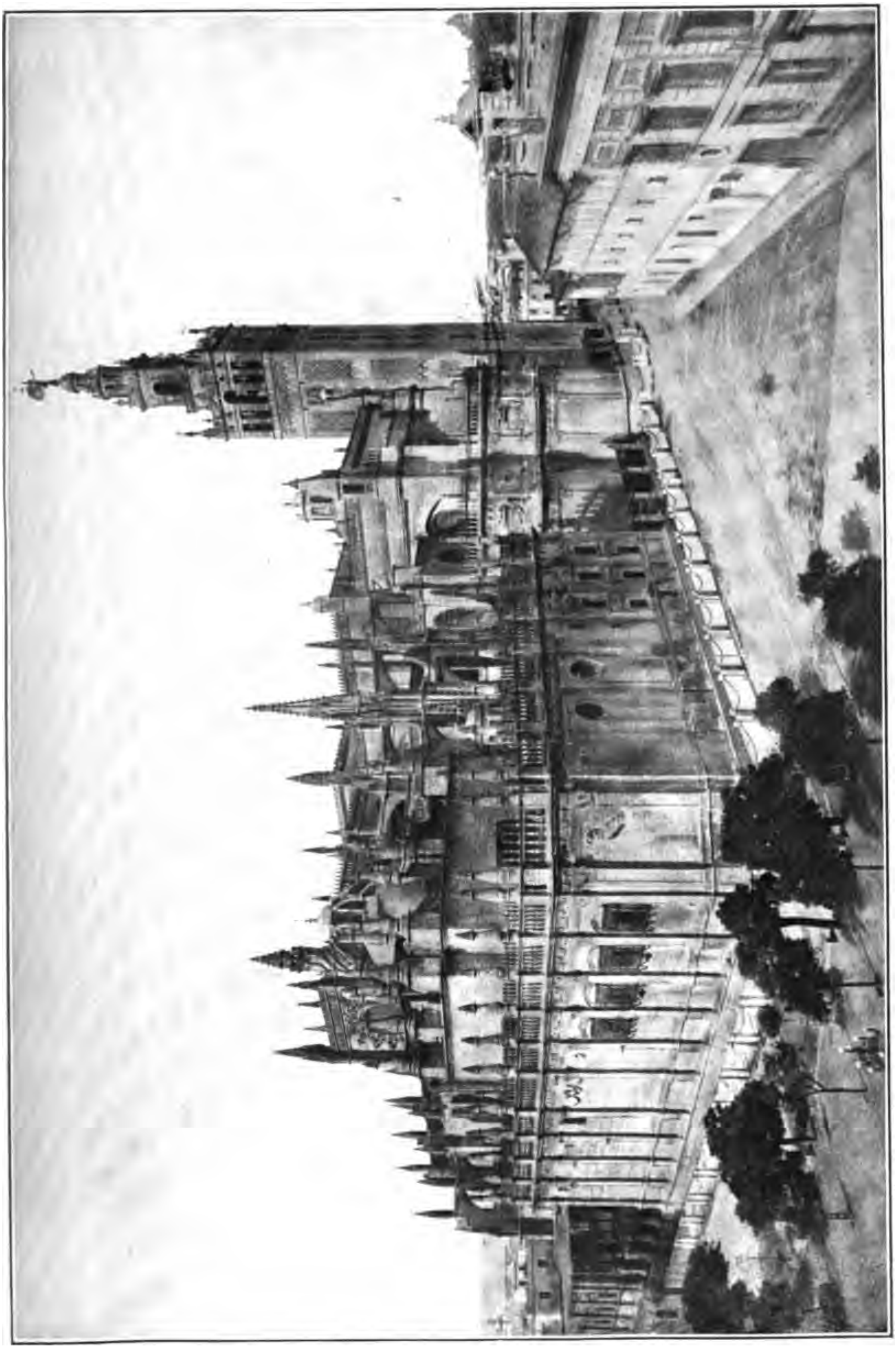
who are found diffused over all parts of the Peninsula. The Spaniards proper, to whom only it is necessary here to advert, are of middle stature, well formed, of a sallow hue, sharp features, dark hair and keen black eyes. In diet the Spaniards are frugal and temperate. Their wants being thus comparatively few, are easily satisfied and furnish no strong stimulus to exertion. Indolence accordingly is a prevailing vice, and the highest ambition generally felt is to be able to live without doing anything. In their intercourse with strangers they are reserved, taciturn and stand much upon their dignity, afraid apparently of its being encroached upon by undue familiarity; but on finding what they conceive to be their true place properly recognized, they lay aside their restraint, form strong attachments and become the most agreeable of companions. With their natural indolence there is a strange mixture of enthusiasm, and when their passions are once roused there are few extravagances or excesses of which they are not capable. In favorable circumstances this part of their character has often manifested itself in chivalric exploits.

History.— Spain was known to the Greeks and Romans as Spania, Hispania and Iberia. The most ancient inhabitants of Spain appear to have been the Iberians, who also extended beyond the Pyrenees into Gaul as far as the Rhone. To these afterward were joined certain tribes of Celts, who succeeded in making a settlement for themselves in the country after sanguinary contests with the aborigines. In process of time the two races were amalgamated into one and went under the common appellation of Celtiberians. These occupied principally the high table-land in the centre of the country. The other parts were occupied by tribes of Iberians and Celts who had never intermingled.' Pure Iberian tribes, from whom are descended the modern Basques, were to be found in the Pyrenees and on the coasts, while the unmixed Celts inhabited the northwestern corner of the country, corresponding to modern Galicia. The Phœnicians were the first civilized nation who made a descent on the peninsula and founded settlements there. Somewhat later the Greeks made their appearance, and among other colonies founded Saguntum. But more important than any of these were the colonies established by the Carthaginians. The history of Spain, indeed, only properly begins with the Carthaginian invasion, about 238 B.C. Previous to that almost all that was known of the country was the existence of the two commercial states of Tartessus and Gades, both in the west. The former of these, supposed to have been the Tarshish of Scripture, was much visited by Phœnician ships by reason of its mineral wealth. After the First Punic War the Carthaginians began to establish themselves in Spain; large tracts of territory were brought under their sway by Hamilcar (238–229), and again by Hasdrubal (228–221); and among the cities founded by them was New Carthage, the modern Carthagena, which soon became a celebrated emporium. The subjected territory extended as far north as the Iberus (Ebro). Pressed by the Carthaginians, the Greek colonies of Saguntum and Emporiæ applied for aid to the Romans, who already had had their jealousy roused by the successes of their great rival. The Romans interfered, and a treaty was then concluded between the two great powers, in terms of which the Carthaginians bound themselves not to extend their conquests beyond the Iberus. The city of Saguntum was on the west side of the river, but under Roman protection, and the capture of it by Hannibal in 219 was the immediate cause of the Second Punic War, which was partly carried on in Spain, and which in 206 caused the total expulsion of the Carthaginians from the peninsula. The Romans now undertook the subjugation of the entire country, but in this they did not completely succeed until after a war of about 200 years' duration, in which the exploits of the Lusitanian Viriathus, the heroic resistance and final downfall of Numantia (133), and the temporary independence of a part of the country under the gallant Setorius (84–73) form brilliant episodes. The Cantabrians, Asturians and other tribes in the mountains of the north were the last to yield, but were finally subjugated by Augustus and his generals, and Spain was converted into a Roman province. Previous to this the peninsula had been divided by the Romans into two parts, an eastern and a western, separated from each other by the Iberus, called respectively Hispania Citerior and Hispania Ulterior; but Augustus made a new division of the country, forming it into three provinces — Tarraconensis, Bætica and Lusitania. Tarraconensis and Lusitania were erected into imperial provinces and administered by legates; while Bætica, which still remained for a long time a senatorial province, was placed under the authority of a proconsul invested with civil authority only. Until the reign of Antoninus Pius, who granted to all his subjects a uniform constitution and laws, the cities of Spain were ruled by different laws. These and other measures made Spain one of the most flourishing provinces of the empire, and a centre of Roman civilization. Some of the most distinguished Latin writers under the empire were natives of Spain, such as the two Senecas, Lucan, Martial, Quintilian and others. Christianity was early introduced into Spain, and after the conversion of Constantine the Great became the dominant religion there. The disorganization and confusion consequent upon the fall of the Roman Empire facilitated the conquest of the country by the Vandals, who made themselves masters of a part of southern Spain, which from them received the name of Vandalusia (now Andalusia); the Suevi, who established themselves in the region now known as Galicia; and the Alans, who gained possession of Lusitania, now Portugal. These, however, were soon afterward attacked by the Visigoths, who, after many years' struggle, succeeded in reducing the whole peninsula to their sway. The Vandals of Andalusia, unable to withstand them, withdrew into Africa in 428, and from 467 to 484 the great Euric extended the kingdom of the Visigoths by the expulsion of the Romans and gave them their first written laws; while Leovigild in 585 overthrew the kingdom of the Suevi in Galicia. Under Leovigild's successor, Reccared I, the introduction of the Catholic faith in 586 gave the corrupt Latin language the predominance over the Gothic, and after that time the unity of the Spanish nation was maintained by the Catholic religion and the political influence of the clergy. But after retaining the mastery of the country for nearly two centuries the Visigoths were in their turn conquered by the Arabs or Moors of Africa, who had come across at the invitation of the family of Alaric, the latter being eager to avenge themselves on their countrymen for being passed over in the election of king. King Roderic fell in the seven days' battle against Tarik at Xeres de la Frontera, in Andalusia, in 711. After that the greatest part of Spain became a province of the caliphs of Bagdad.

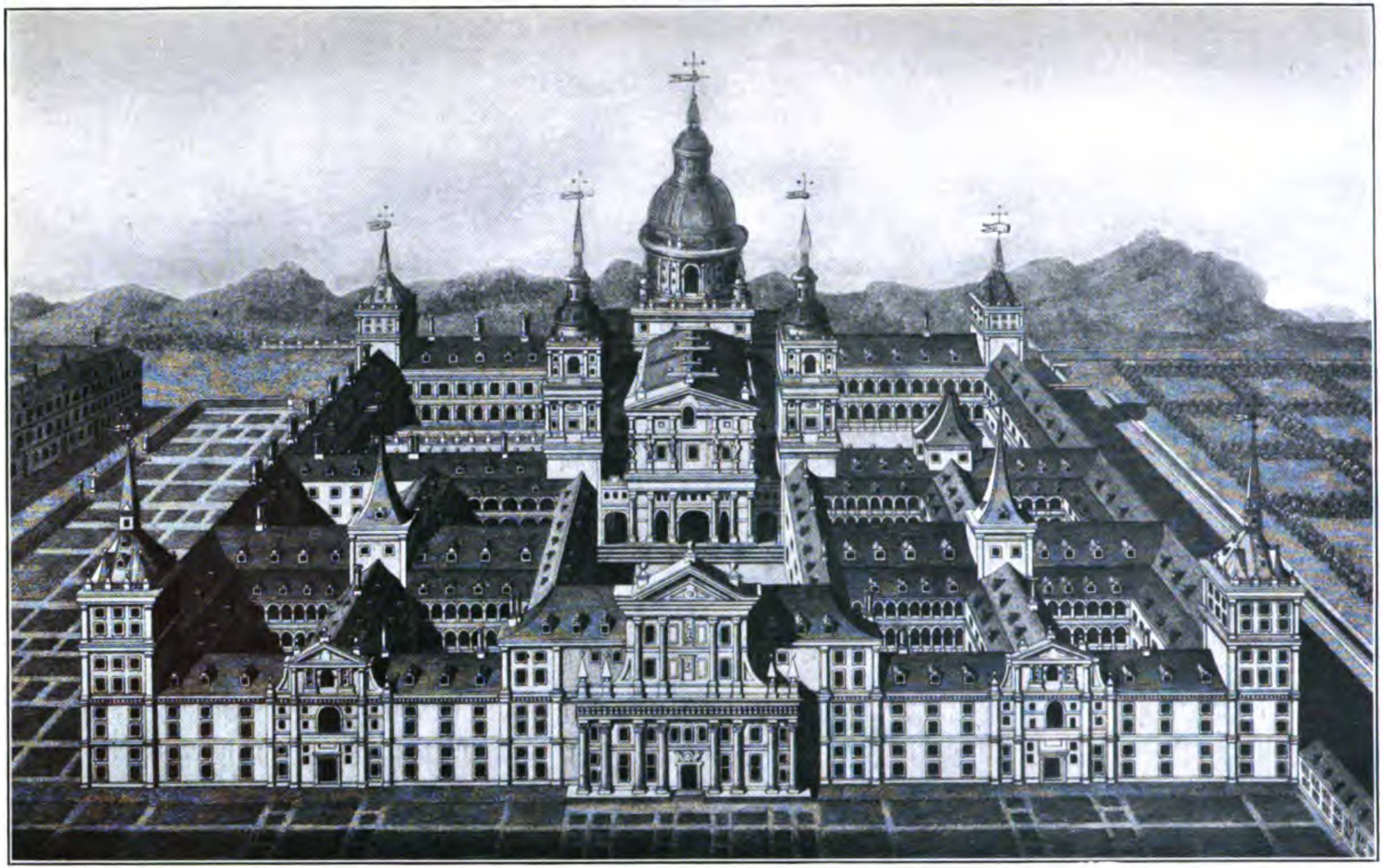
For some years after their conquest of Spain the Moors held it as a dependency of the province of North Africa; but it was afterward (717) governed by emirs appointed by the caliphs of Damascus. The policy of the Spanish emirs was to extend the Moorish dominion beyond the Pyrenees into Gaul, and the 40 years of their rule was marked by much bloodshed and anarchy, consequent on their disregard of internal affairs. About the year 756 Abd er Rhaman I, the last caliph of the dynasty of the Ommiades, having been driven from Damascus, where he was replaced by the Abassides, succeeded in overthrowing the government of the latter in Spain and established the independent caliphate of Cordova, which under Abd er Rhaman III and his son Hakkem II, who died in 976, reached its zenith of power and prosperity. After the deposition of Hescham III the caliphate rapidly declined, for when that event took place the various governors of provinces declared themselves independent and assumed the title of kings. Thus Arabian princes reigned at Saragossa, Toledo, Valencia and Seville, where not only the language but also the manners of the Moors at that time prevailed almost universally. Still the free exercise of their religion was allowed to the Christians, and also the retention of their language, laws and magistrates.

Meantime the Visigoths, who had succeeded in maintaining their independence in the mountains of Asturia and Galicia, founded under Pelayo in 718 the kingdom of Oviedo. The second successor of Pelayo, Alfonso I the Catholic, conquered Galicia, with a part of Leon and Castile, and assumed the title of king of the Asturias. The remainder of Leon was conquered by Alfonso III, whose son, Ordoño II, transferred his residence to the city of Leon, and called his dominion the kingdom of Leon (914). The kingdom of Navarre came into existence in the 9th century. It formed a part of the Spanish territory of Charlemagne, obtained by conquest from the Arabs, and extending south of the Pyrenees as far as the Ebro. Near the sources of the Ebro and Pisuarga arose even earlier the kingdom of Castile. At first a small republic, consisting of only a few towns, it appears afterward as a country with a considerably enlarged territory, and somewhat later its princes assumed the title of king. In 1037, after the death of the last king of Leon, Ferdinand I of Castile united that kingdom with his own and Castile was henceforth the most powerful Spanish state. Aragon, Galicia, Portugal, Murcia and other states owed their origin to the prevailing custom of dividing a kingdom among the sons of a deceased monarch. Though frequently at war with each other the Christian princes generally united against their common foe, the Moors, who were daily becoming less able to cope with them. About the end of the 11th century Mohammed of Cordova and Seville applied for assistance against Alfonso VI of Leon and Castile to the Almoravides, the founders of the empire of Morocco. In compliance with the request of Mohammed the Almoravides entered Spain and gained some successes over Alfonso; but they then turned upon Mohammed himself, obliging him to yield them a portion of his territory, and the Almoravide sovereign was ultimately acknowledged sole monarch of Mohammedan Spain. The Almoravides, however, were overpowered in their turn by another Mohammedan tribe, the Almohades, about the middle of the 12th century. Meanwhile the Christian kings were making still further encroachments on the territory in possession of the Mohammedans, and after the great victory they obtained over the Almohades on the plains of Tolosa, in the Sierra Morena, in 1212, there remained to the Arabians only the kingdoms of Cordova and Granada, and even these were soon afterward obliged to recognize the supremacy of Castile. The two most important Christian states of Spain were Aragon and Castile, and they ultimately absorbed all the others. Aragon, which had been wrested from the Moors by Sancho III and left as an independent kingdom to his son Ramiro, fell by inheritance in 1131 to the counts of Catalonia and was afterward greatly enlarged under successive kings. Jayme I wrested from the Moslems the island of Majorca in 1229, and the whole of the kingdom of Valencia in 1239. Pedro III married Constance of Sicily, and notwithstanding the opposition of the Pope took possession of that island after the massacre of Sicilian Vespers (see SICILIAN VESPERS) in 1282. Jayme II effected the conquest of Sardinia in 1326, and Alfonso V united Naples with his kingdom. Meanwhile the internal affairs of the kingdom had been thrown into confusion through civil dissension resulting from the heavy imposts laid upon the people; but a remedy was found in increasing the power of the Cortes. Aragon was the first Christian state in which the third estate obtained a legal position. The Cortes, consisting of representatives of the nobility, of the clergy and of the towns, received more extensive privileges, and the king could not act in important matters without their consent. On the extinction of the Catalonian line of princes, Ferdinand, infante of Castile, was elected king by the Cortes in 1412, and his descendants ruled over Aragon until, through the marriage of Ferdinand V of Aragon with Isabella of Castile, Christian Spain was consolidated into one kingdom. Ferdinand I, second son of Sancho, was the first king of Castile in 1033, and as already mentioned joined the kingdom of Leon to the crown of Castile. He waged successful war with the Moors, took several towns and exacted tribute from the Mohammedan king of Toledo. It is to this reign that the greater number of the exploits of the famous Rodriguez Diaz de Bivar, known under the name of Cid, belongs; and according to Viardot the establishment of the Cortes dates from the same reign. Under Alfonso VI Castile acquired an accession of importance through the annexation to it of the crowns of Leon (which had become again disunited), Galicia and Navarre, and above all through the conquest of Toledo and its territory, out of which was formed New Castile. Notwithstanding the success of its arms the country suffered much. Oppressed by taxes and desolated by war it was far from being in a prosperous condition. Under Ferdinand III, who ascended the throne in 1217, Cordova, Jaen, Alcala, Seville, Cadiz and other places were wrested from the infidels; and again under his successor, Alfonso X (1252–80), further conquests were made, though some losses were also sustained. To the latter prince is due the introduction of the third estate into the national assemblies, and the adoption of the vernacular for public acts. Alfonso XI (1324–50), like his predecessors, spent most of his time in warring with the Moors; he gained in 1340 the celebrated battle of Salados and made himself master of Algesiras in 1344. In 1465 Henry IV was deposed by his turbulent vassals and the crown given to Isabella, whose marriage with Ferdinand of Aragon in 1469 led to such important results. The marriage of these two sovereigns did not lead immediately to a complete coalescence of the two kingdoms, for they retained the separate administration of their respective dominions. But in concert with their great minister, Cardinal Ximenes, they proceeded harmoniously with the work of fusing all the states of Spain, which still differed in religion, customs and laws, into a political and ecclesiastical unity, at the same time seeking to strengthen the royal authority at the expense of the clergy, the aristocracy and the towns. By a severe administration of justice, and by the institution of the Santa Hermandad, or Holy Brotherhood — a body of about 2,000 police armed and mounted for the purpose not only of putting down the robberies and violence which everywhere abounded, but also of forming a check on the power of the nobility — order was established throughout the country. The royal power was moreover strengthened and extended by the establishment of the Inquisition (q.v.). Warfare also was carried on by Ferdinand against the Moors of Granada, which, undertaken in 1481, culminated 10 years later in the reduction of the capital of that kingdom, which surrendered to Ferdinand 25 Nov. 1491. With the fall of Granada fell the Moslem empire in Spain, after having existed nearly seven centuries and a half, and Spain, with the exception of Navarre, was now consolidated into one great kingdom. An order was issued, 30 March 1492, for the expulsion of all Jews who did not submit to be baptized, whereupon nearly the whole race, rather than sacrifice their religion to their worldly interests, left the country. In this sentence of banishment the Moors were also included and the departure of the industrious Jews and Moors proved a fatal blow to the flourishing commerce of the country, which was further affected by the discovery of America by Columbus in 1492, this being the means of withdrawing much of the activity of the nation from the improvement of the mother-country. While Spain consummated its complete political consolidation at home by the conquest of Navarre, the conquest of Naples by Gonsalvo, and still more the occupation of large portions of North, Central and South America by Spanish generals, soon raised the new kingdom to the front rank of European powers. Ferdinand was succeeded in 1516 by his grandson, Charles I (Charles V of Germany), who permanently united Castile and Aragon. (See CHARLES V). At the beginning of his reign serious insurrections broke out in Valencia and Castile, where the people demanded a more liberal constitution; but they were soon quelled and resulted in the abolition of the principal rights of the towns, the restriction of the powers of the Cortes and a stronger attachment of the clergy and nobility to the Crown. The victory of the Spaniards at Pavia 24 Feb. 1525, which made Francis I the prisoner of Charles, and the expedition against Tunis and Algiers, extended the fame of the Spanish arms throughout Europe. But these wars together with those carried on against the Protestants of Germany, against the people of Ghent in the Netherlands and against Pope Clement VII in Italy, exhausted the revenues of the country. The immense wealth that flowed in from Mexico, conquered by Cortes in 1518, and from Peru and Chile, conquered by Pizarro and Almagro in 1531, was not sufficient to supply the demands of the royal treasury, and though the taxes were largely increased a heavy debt had to be contracted. With the reign of Philip II (1556–98), the son of Charles, the great monarchy began to decline. Oppression and religious intolerance, war and insurrections, occasioned the loss of the Netherlands and depopulated the rest of the monarchy; and the conquest of Portugal, which remained united with Spain from 1581 to 1640, could not prevent its decay. England and Holland triumphed over the naval force of Spain and destroyed her commerce; and Philip died in 1598 a bankrupt. This calamitous period was nevertheless the golden age of literature and art in Spain and the Spanish language and fashions controlled the courts of Europe. Under the reign of the indolent and incapable Philip III (1598–1621) the country took still greater strides toward decay. The Duke of Lerma, his insatiable favorite, in order to augment his own fortune and that of his partisans, squandered in a most scandalous manner the public revenues; and he struck another blow at the commerce of the country by expelling, in 1609, the last remnants of the Moriscos, to the number of 600,000. Equally damaging to the interests of the country was the reign of Philip IV (1621–65), notwithstanding some energetic measures taken by Olivarez, the able minister of that monarch. The wars which were carried on in Germany, Italy, the Netherlands and France — the war with the last-named country ending in the loss to Spain of Roussillon — helped to complete the ruin of the country and stirred up revolts in Catalonia, Andalusia and Portugal. The civil war in Catalonia lasted about 10 years and in 1640 Portugal recovered her independence. The son of Philip IV, Charles II (1665–1700), a prince weak alike in mind and body, was obliged, after disastrous wars, to cede to France many places in the Netherlands and Franche Comté. The population of Spain, which had amounted to 11,000,000 in 1688, fell off to about 8,000,000 at the beginning of the 18th century.

Charles II, the last Spanish sovereign of the race of Hapsburg, in his second will made Philip of Anjou, a grandson of his sister, the consort of Louis XIV, sole heir of his dominions, in order to prevent the division of the Spanish monarchy, which had been resolved on in a treaty between England, Holland and France. Louis XIV acknowledged his grandson king, according to the testament; but the Emperor Leopold I, of the race of Hapsburg, laid claim to the throne, while William III, king of England and stadtholder of Holland, was in favor of a division of the monarchy for the sake of preserving the balance of power in Europe. The measures of Louis XIV at length brought on a war with England. Thus began the War of the Spanish Succession, which lasted 12 years and in which the Bourbon, Philip V, after many changes of fortune, succeeded in maintaining himself, by the victories of Berwick and Vendôme, on the Spanish throne in opposition to Charles of Austria (afterward the Emperor Charles VI). But by the Peace of Utrecht in 1713 he was obliged to resign the Spanish dependencies in Europe — Naples, Sardinia, Parma, Milan and the Netherlands to Austria, and Sicily to Savoy. England likewise retained Gibraltar and Minorca, the later of which was restored somewhat later. Under the Bourbons the nation lost its last constitutional rights; Aragon, Catalonia and Valencia were treated by Philip as conquered countries. The last diet of the Cortes held in Castile was in 1713 and in Aragon in 1720. Biscay and Navarre alone retained some of their privileges. The ambition of Cardinal Alberoni involved Europe for a short time in confusion. Spain in 1735 again obtained possession of the Two Sicilies for the Infant Carlos and of Parma for the Infant Philip in 1748. Ferdinand VI (1746–59) succeeded his father, Philip, but being a prey to hypochondria took no active part in the government. With his stepbrother, Charles III (1759–88), previously king of Naples, an enlightened prince, better days dawned for Spain. Under his reign the Bourbon family compact of 1761 involved Spain, to its injury, in the war between the French and British. The expeditions against Algiers likewise miscarried, as did the siege of Gibraltar in the war of 1779–83. Yet this did not disturb the course of the internal administration to the improvement of which men like Aranda, Campomanes, Olavides and Florida Blanca devoted themselves. They provided particularly for the advancement of agriculture, the useful arts and commerce, and this had a beneficial effect on the population, which now rapidly increased. The progress in improvement became even more marked during the early part of the reign of Charles IV (1788–1808), who at first pursued the reforming policy of his father; but in 1792, when Florida Blanca was superseded by Godoy as Prime Minister, he fell under the pernicious influence of that favorite. Spain at first entered with zeal into the war against the French Republic; but by the influence of the favorite the discreditable Peace of Basel was concluded, by which Spain resigned Santo Domingo to France, an offensive and defensive alliance with France was entered on (1796) and war declared against Britain. In 1797 the Spanish fleet was defeated near Cape Saint Vincent, Minorca and Trinidad occupied by the English and all the ports of Spain blockaded. By the Peace of Amiens in 1802 the British were confirmed in their possession of Trinidad. In 1801, at the instigation of France, military operations were commenced against Portugal, which was obliged to cede the province of Olivença to Spain at the Peace of Badajoz in 1802, while France raised the Duke of Parma to the dignity of king of Etruria in 1801, Spain in return ceding Louisiana to France. Charles IV, on the renewal of the war between Britain and France in 1803, having purchased permission to remain neutral by a monthly tribute of 6,000,000 francs to Napoleon, the British seized the Spanish galleons and thereby forced Spain to declare war against Britain. The victory of the British at Trafalgar, 21 Oct. 1805, destroyed its naval power. The misery occasioned by the unfortunate wars carried on by Spain at this time led to the formation of a powerful party against the unscrupulous Godoy, who was mainly instrumental in bringing about these wars. Some feeble efforts were made by him to free Spain from French domination; but the success of Napoleon in his war with Prussia thwarted those and in terms of the alliance subsisting between Spain and France a requisition of Napoleon to dispatched two Spanish armies to Denmark and Tuscany, respectively, had to be complied with. Spain received a further humiliation by the Treaty of Fontainebleau respecting the division of Portugal, in consequence of which French troops were marched into the country. Toward the end of 1807 large bodies of French troops entered Spain at different points and occupied on one pretense or another some of the strongest fortresses in the north. The entrance of a French army 35,000 strong in March 1808 raised the numbers of French troops in the country to 100,000 and with Murat at their head they now marched on Madrid. Godoy, in despair of his life, counseled the flight of the king and queen to Mexico. The project got wind; the people broke into open insurrection and the reign not only of the favorite but of his master also was at an end. Charles IV abdicated in favor of his son, the Prince of Asturias, who ascended the throne as Ferdinand VII. Ferdinand made a public entry into Madrid, which had been occupied by Murat, Grand Duke of Berg, the day previous. He informed Napoleon of his assumption of the royal power; but the emperor caused the whole family to be conveyed to Bayonne. Charles IV, who had retracted his resignation of the crown, and Ferdinand VII, the new king, were now both in the hands of Napoleon. Taking advantage, therefore, of the opportunity, he extorted from each of them, as well as from the Infantes Don Carlos and Don Antonio, a resignation of their claims to the Spanish crown. The crown, which had already been refused by his brother Louis, king of Holland, was now offered to another brother, Joseph, the king of Naples, by whom it was accepted. The Council of Castile, the chief political body of Spain, when informed of the treaties of Bayonne, was at length induced to give a reluctant assent to the accession of Joseph. A junta of 150 Spanish notables which had been summoned to Bayonne accepted a constitution proposed by Napoleon for Madrid. The Spanish people, who were so little taken into account in these changes, were by no means passive spectators of them. Insurrections had already broken out immediately after the abdication of Charles in May. The people in Asturias first took up arms; Aragon, Seville and Badajoz followed. Palafox carried from Bayonne to Saragossa the order of Ferdinand that the people should arm, and the supreme junta received permission to assemble the Cortes. Revolution broke out everywhere, which



Cathedral and Alcazar at Seville



THE PALACE OF THE ESCORIAL.

the French were too weak to resist. Moncey retreated to Valencia, and Generals Dupont and Wedel were beaten at Baylen. The junta at Seville had issued a proclamation calling the people to arms and the Council of Castile decreed a levy of 300,000 men. The French squadron at Cadiz surrendered to the Spaniards and six days later an insurrection broke out in Portugal. On 4 July 1808, the alliance of Great Britain with the Spanish nation was proclaimed and a struggle began, which, whatever opinion may be entertained respecting the conduct of Napoleon, everyone will admit to have brought with it, as far as respected Spain, little but evil. Marshal Bessières was successful in the battle at Medina del Rio Secco, over General Cuesta; but the affair at Baylen above mentioned decided the retreat of the French from Madrid, and, 23 August Castanos entered the city. In the meantime Sir Arthur Wellesley (Wellington) had disembarked in Portugal at the head of the British forces and on 21 August gained the first important battle in the Peninsular War, defeating the French under Junot at Vimeiro. On 30 August the convention of Cintra was concluded, by which the French agreed to evacuate Portugal. A central junta under Florida Blanca was organized at Aranjuez toward the end of September; but unity did not prevail in it and the favorable moment was allowed to escape. On 6 November Napoleon reached the Ebro at the head of a large force and by a succession of victories gained by his generals under his direction his way was opened to Madrid, which he entered on 4 December. The central junta now retired to Badajoz and afterward to Seville. The Spaniards believed that the success of the French was owing to treachery and this suspicion occasioned the assassination of more than one of their generals. The French indeed gained many victories and took many fortresses; but the conquerors remained masters only of the places which they occupied. Everywhere the invading troops were surrounded and harassed by the attacks of the Spanish guerrillas. No line of communication was safe for the French; their means of support failed. In vain did Napoleon, 4 Dec. 1808, abolish the feudal privileges and the Inquisition; in vain did Joseph try every means to win the love of the people; nothing could avail against the hatred of a Gallic yoke. Austria now declared war and Napoleon was obliged in January 1809 to leave the conduct of the war in the Peninsula to his marshals — a step which the Spaniards considered as equal to a victory. During the following five years the French generals did all that talent and courage could do; but the charm of Napoleon's presence was wanting and Wellington finally triumphed over them. See PENINSULAR WAR.

After Pampeluna had fallen, 31 Oct. 1813, no French soldier was left on the Spanish territory except in Barcelona and some other places in Catalonia. Wellington attacked the enemy on the fortified banks of the Nivelle 10 November and Soult retreated into the camp of Bayonne. On 26 Feb. 1814 Wellington fought a battle with Soult at Orthez, by which the latter was driven from his strong position and obliged to retreat in great disorder to the upper Garonne. Wellington followed the French under Soult to Toulouse, where the bloody battle of 10 April and the occupation of the place put an end to the war.

The Cortes had already held its first session and had resolved that Ferdinand VII should swear to preserve the constitution before he should be recognized as king. At their invitation Ferdinand now returned to Spain, but declared the constitution null and void; the Inquisition was revived, despotism was restored and the greater part of the reforms introduced under Charles III were subsequently annulled. Ferdinand bore down all opposition with a high hand and for six years (1814–20) reigned with absolute power. From 1814 to 1819 there were 25 changes in the ministry, mostly sudden and attended with severities. They were produced by the influence of the *camarilla* or persons in the personal service of the king. Every attempt to save the state was frustrated by such counsellors and the prestige of Spain was further lowered by the loss of the American colonies, an attempt to reconquer which only resulted in a miserable failure. On 1 Jan. 1820, a military insurrection under Riego broke out, for the purpose of restoring the constitution of 1812. It spread with great rapidity; several generals, as O'Donnell and Freyre, who were dispatched to suppress it, joined the insurgents and Ferdinand, abandoned by his own troops, was obliged to swear to observe the constitution of 1812. Among other reforms the Inquisition was abolished. The Cortes being assembled immediately set themselves to frame such measures as should be calculated to restore tranquillity to the distracted country. But this was a task well nigh impossible under the circumstances. The country was divided into opposing factions — those who favored the restoration of its ancient power and privileges to the Crown and those, on the other hand, who advocated liberal or ultra-liberal measures, and the measures passed had no effect in allaying the discontent. Guerrilla bands were organized in the provinces in the cause of Church and king and obtained the name of «armies of the faith.» There was even established at Seo d'Urgel in July 1822 what was called «a regency during the captivity of the king.» The government, however, was powerful enough to disperse these guerrilla bands and drive the regency into France. In these civil disturbances dreadful atrocities were committed on both sides. In the meantime France, at the Congress of Verona in October 1822, had agreed with the courts of eastern Europe upon an armed intervention in Spain. The Spanish government was called upon to restore the royal sovereignty and to change the constitution, and when they declined to comply a French army 100,000 strong, under the Duke of Angoulême, crossed the Pyrenees in the spring of 1823. By means of this force Ferdinand was restored to absolute power and immediately revoked all the decrees passed by the constitutional government between March 1820 and October 1823. The Inquisition, indeed, was not restored; but the secular tribunals supplied its place and performed deeds of vengeance of the most atrocious description. The whole Spanish army was now disbanded and its place supplied by the «army of the faith,» who plundered and murdered the constitutionalists to their hearts' content. It is computed that 40,000 constitutionalists, chiefly of the educated classes, were thrown into prison. To restrain the violence of party fury a treaty had been concluded with France, stipulating for the maintenance of a French force of 45,000 men in the country, until the Spanish army could be organized. It was only in 1827 that the French evacuated Spain. The personal moderation of the king toward the constitutionalists led to the formation of a plot by the absolutists to compel him to abdicate and to raise Don Carlos, his brother, to the throne (thence their name of *Carlistas*). Several insurrections were set on foot by these Carlists, which were attended with numerous executions. In 1830 Ferdinand was persuaded by his wife, Maria Christina, a Neapolitan princess, to abolish, by the pragmatic sanction of 29 March, the Salic Law of the Bourbon family, which excluded the daughters of the king from the throne. In consequence of the abolition of this law the succession passed from Don Carlos to Ferdinand's daughter, the Infanta Isabel. Don Carlos and his party protested against this measure, and the death of Ferdinand in 1833 was the signal for civil war. Isabella was at once acknowledged by the leading powers of Europe and proclaimed without opposition in all the midland and southern provinces of Spain. It was otherwise in the north, particularly in the Basque province; there the inhabitants took up arms in behalf of Don Carlos and proclaimed him king, under the title of Charles V. Christina had the joint support of the moderados and the liberals and in order to attach them to her still more, a royal decree was issued in April 1834 granting a constitution with two chambers. The Carlists, under the command of Zumalacarreguy, were at first successful, but on his death their cause began to decline and the skilful leadership of Cabrera failed to retrieve the fortunes of the party. During this struggle England and France allowed men to be recruited within their territories for the cause of the queen and an army of 10,000 went from England to join the royal troops. The chief of the royalist generals were Espartero and O'Donnell, under whose leadership the war was brought to an end in 1840. Though the civil war had thus been brought to a successful termination, Spain had by no means been restored to a state of tranquillity. Christina failed to satisfy the ultra-liberals and rather than consent to have a colleague in the regency, as it was now thought expedient she should have, resigned 12 Oct. 1840, and sailed for France. In May 1841 the Cortes conferred the office of regent on Espartero and that of guardian to the queen on Arguelles. Espartero seems to have had the good of his country at heart, but he had a most difficult rôle to play. Every reform which he attempted gave offense to some party and to whatever side he turned he met only with opponents numerous, resolute and influential. Insurrections broke out in various quarters, and Espartero, checked and hampered on all hands, at last left the country and sailed for England. Queen Isabella was declared of age by the Cortes in 1843 and henceforth the government was carried on in her name. She was married on 10 Oct. 1845 to her cousin, Don Francisco d'Assiz, her only sister, Louisa, being on the same day married to Louis Philippe's son, the Duke of Montpensier. The outbreak of the French Revolution of 1848 caused much less commotion in Spain than in several other Continental states. Any revolutionary movements that took place were easily repressed by Narvaez, a minister of prudence and energy, who was then at the head of the government. Narvaez, however, found no small difficulty in maintaining his position. The court was a mere focus of intrigue and the most important political changes were constantly threatened to be effected by the most frivolous and contemptible means. Early in 1851 he was compelled to resign, and till 1854 a number of short-lived and weak ministries, most of which had reactionary tendencies, succeeded each other. At the head of the last of them was Sartorius, whose measures were so unpopular that insurrection broke out in various quarters, and he and his colleagues, after trying in vain to suppress them, were obliged to save themselves by flight on the 17th of July 1854. Espartero, who had some time before returned to Spain, was now charged with the formation of a government in accordance with the wishes of the nation. Before consenting to undertake this task he made two stipulations — the one that the queen-mother should be exiled, the other that the constituent Cortes should be assembled. On obtaining these concessions he formed a coalition ministry, himself holding the office of President and General O'Donnell that of Minister of War. The coalition ministry did not, however, work harmoniously, and Espartero, after holding his position with some difficulty till 14 July 1856, was obliged to give place to another ministry, with O'Donnell at its head, which only existed three months. Narvaez was now called to the head of affairs (October 1856). But in July 1858, O'Donnell was again entrusted with the formation of a ministry, which, being more liberal than the previous ones, endured for a period of five years, during which Spain enjoyed comparative tranquillity. In 1858 Spain shared in the French expedition against Anam, to avenge the persecution of Catholic missionaries and native Christians, which had been going on for a series of years. On 22 Oct. 1859, war was declared against Morocco, which, it was alleged, had attacked the Spanish possessions situated on the northern coast of that state. Under the leadership of O'Donnell it was carried to a successful conclusion and a treaty of peace was signed on 26 April 1860, in terms of which 20,000,000 piastres were paid to the Spaniards by way of indemnification. These foreign wars led to a considerable increase of the army and navy, promoted peace at home and greatly raised the reputation and influence of Spain abroad. In 1860 an unsuccessful attempt was made to overthrow the government of Isabella by the Count of Montemolin, the eldest son of Don Carlos, in whose favor the latter had in 1845 abandoned his claim to the Spanish throne. In 1861 Spain joined Britain and France in sending an expedition to Mexico to obtain redress of grievances. The same year Spain resumed possession of her former colony of Santo Domingo. On 18 March the last President of that republic, Santana, issued a proclamation announcing the union of that state with Spain, and on 20 May the queen signed the decree by which the annexation was accepted. In 1863, however, a revolt broke out and after some fighting, which continued into the following year, Spain relinquished the possession once more. A quarrel at this time broke out between Spain and Peru, in consequence of which the Spaniards seized the Chincha Islands by way of material guarantee; but in the early part of 1865 the differences between the two governments were adjusted and the Chincha Islands restored to the Peruvian authorities. A more serious rupture took place in the same year with Chile, which led to a war between the two countries. The Chileans were supported by Peru, Ecuador and Bolivia; but Spain had not very much to fear from this combination, though at the same time, as might have been expected, the war procured her little either of honor or profit. A military insurrection broke out in Spain toward the end of 1865, under the leadership of General Prim, but he and his adherents were forced to flee before the royal troops. Prim effected his escape to Portugal, but in the following year another attempt at insurrection was made. On 22 June a regiment of artillery, quartered in Madrid, mutinied in their barracks, and after murdering several of their officers marched through the streets of the city calling upon the people to rise in the name of «Prim and the republic.» The active measures, however, of the Prime Minister, Marshal O'Donnell, soon put down the revolt. An equally abortive rising, though on a larger scale, took place in August 1867 in Aragon, Catalonia, Valencia and elsewhere, where bands of armed men made their appearance, and were in some instances joined by the mayors of towns and other functionaries. The movement in a short time wholly collapsed, and several persons engaged in it were taken prisoners and executed. But the Revolution of 1868 had a very different issue. The conduct of the queen had alienated all feelings of loyalty in the breasts of her subjects. The forms of the constitution had been abused, and made the machinery of arbitrary and oppressive rule, and the people were weary of a system which repressed all freedom of thought and rights of conscience, which placed the education of the young in the hands of Jesuits, and under which they had lost all respect for their ministers and all attachment to the Crown. In the month of April insurrectionary movements broke out in Catalonia, and the province was placed in a state of siege. In July several Spanish generals were arrested by the government, and without any form of trial sent into exile. The revolution burst forth in September. On the 17th of that month General Prim arrived at Cadiz, where the exiled generals also arrived two days later, and immediately lent themselves to the movement. Meanwhile a proclamation had been issued calling the people to arms. Marshal Serrano, formerly president of the Senate, placed himself at the head of the movement and the whole of Andalusia pronounced for the revolution. The Spanish ministry resigned, and General Concha was appointed by the queen president of the council. The Marquis de Novaliches commanded the royal army, and marched upon Cordova, which was occupied by the insurgents. At Burgos a severe conflict took place, which resulted in the royal troops fraternizing with the people. Juntas were established in the different towns, which one after another raised the flag of rebellion. The defeat of Novaliches at Puerta Alcalen and the formation of a provisory junta at Madrid determined Isabella to flee the country and take refuge in France. Immediately after her flight the fall of the Bourbons was solemnly proclaimed, and one of the first acts of the juntas was to recognize universal suffrage as a principle of the future constitution. Serrano entered Madrid at the head of the revolutionary troops on 3 October and was received with the utmost enthusiasm by the inhabitants. A few days later a provisional ministry was formed, «to lead the nation to liberty, and not allow it to perish in anarchy.» Decrees were passed suppressing the Society of the Jesuits, declaring the absolute freedom of primary education, and restoring the liberty of the press. Thus was accomplished with little violence and less bloodshed a revolution which marks one of the most important eras in Spanish history. The Cortes of 1868 declared for the monarchical form of government; but it was no easy task to find a prince both able and willing to fill the hazardous post of king. After fruitless negotiations with several princes, which, in the case of one of them, the Prince of Hohenzollern, led indirectly to the disastrous Franco-German War (q.v.) of 1870, the Crown was at length accepted by Amadeus, the second son of Victor Emmanuel, and on 16 Nov. 1870, he was formally elected as king by the Cortes. Meanwhile insurrectionary movements in several of the provinces had disturbed the peace of the country, but were forcibly suppressed. The new constitution was promulgated 6 June 1869, and Serrano appointed regent until a king was elected. The two years' reign of Amadeus I failed to give peace to the much disturbed country. Parties were numerous and irreconcilable. One ministry had to give place to another, each successive change making matters worse instead of better. To crown all, in April 1872, the Carlist insurrection, which had been for some time threatening, burst forth. Risings took place simultaneously, under old chiefs of the party, in Aragon, Navarre and the Basque provinces; and bands also rapidly formed in Leon, Castile, and elsewhere. The cry of «Viva Carlos VII» was heard on all sides. No time was lost by the government in dispatching Marshal Serrano to the scene of action. He succeeded in driving the insurgents before him, and coming up with the main body on 4 May at Oroquieta defeated them. The check they received was, however, only temporary, as they still kept up a species of güerrilla warfare, and the year 1872 closed amidst widespread confusion in the provinces, and excitement in the capital itself. «The Carlists in the north, the federalists in the south, overran the country, exacting contributions, cutting the railways and telegraph wires, inflicting heavy damages upon the state and on private families, putting a stop to all commercial intercourse, undermining local trade, protecting and facilitating smuggling, and obtaining unlimited authority wherever they went»; and in this state of disorganization the country continued long after all active fighting had ceased. Disaffection in the army added to the strife of parties, and the many opposing manifestations of public opinion at length determined the king to resign a crown the wearing of which had caused him nothing but anxiety and unrest. He accordingly abdicated on 11 Feb. 1873; and immediately thereupon the Cortes, by a majority of votes, declared for a republic, which was officially proclaimed at Madrid on 16 February. This was followed by political complications of the most chaotic description, a state of affairs which the Carlists were not slow in taking advantage of. Not only, however, were the Carlists active, but other insurrectionary movements, consequent on the general discontent, combined to complicate the difficulties of the government. On 8 June the form of government, which had been the subject of much dispute, was, by an almost unanimous vote of the Cortes, definitely declared to be that of a federal republic. The Ministers under it were as short-lived as previously. On 21 September Castelar, who at that time was President, was invested with dictatorial powers by a resolution of the Cortes, who voted their own suspension till 3 Jan. 1874. At the expiration of that period matters were in no way improved. Public opinion was wholly disorganized, and the Carlist war had gained formidable dimensions. January 3 saw another revolution of government; the Cortes had reassembled, and on a motion being made for the approval of Castelar's exercise of authority during the recess it was negatived by a large majority. Castelar at once presented the resignation of himself and cabinet. As soon as this event was known out of doors, General Pavia, the captain-general of Madrid, at the head of his troops, entered the chamber and forcibly dissolved the Cortes; and having assembled the chiefs of the Revolution of 1868, and leading men of all political parties, justified his conduct by the urgency of the case, and desired them to form a new coalition ministry. The parties now placed in power, with Serrano at their head, were the same with those who made the Revolution of 1868 and the constitution of 1869. During this new revolution Madrid remained tranquil; but in Saragossa, Barcelona and Valencia volunteers were arrayed by the communal authorities against the troops of the government, and barricades were raised. The struggle, however, was of short duration, and soon quelled. Within 10 days after the inauguration of the new government a striking military success, in the capture of Carthagena from the disaffected, came to give it credit. In the north the Carlist War still raged, and became more and more formidable. Bilbao made a stubborn resistance to the government troops, but ultimately fell, and this success was followed by a few others; but at the battle of Estella, fought on 27 June, the Carlists obtained a signal victory over the republicans, who lost nearly 5,000 men in killed, wounded and prisoners. The Carlists now overran the northeastern provinces, the fortresses only holding out against them. On 15 July, after a terrible bombardment, Cuenca fell into their hands. By the beginning of September the pretender's troops had entered several towns in different parts of Spain, though they had been, for the most part, unable to retain their acquisitions. The tide of success, however, again turned against the Carlists. They met with a signal defeat near Pampeluna on 25 September and again at Irun on 11 November; but the republicans failed to follow up their successes or act as if they had any desire to bring the war to a speedy conclusion. Meanwhile another political change was in contemplation. The Alfonsists, or advocates of the Prince of Asturias, son of the ex-queen, consisting of a large majority of the middle and upper class of society, had been working steadily in his interests. On the prince's 17th birthday addresses had been presented to him at Sandhurst, in England, where he was pursuing his military studies as cadet; and on the last day of the year it was announced that Gen. Martinez Campos, proclaiming Prince Alfonso as king, had entered Valencia with two brigades. On the same day he was proclaimed in Madrid under the title of Alfonso XII. On 9 June 1875, the new king landed at Barcelona and assumed the government of Spain. The Carlist rebellion dragged itself on for more than a year after this event, but with fainter and fainter hopes of success. On 22 Feb. 1876, five battalions of Carlists surrendered at Tolosa to General Campos, and four days later Don Carlos fled to France. On 20 March following the young king made a triumphal entry into Madrid. Spain enjoyed a time of peace until his death in his 29th year, November 1885. His wife, Christina of Austria, was proclaimed regent after the birth in 1886 of her posthumous son, who is now king under the title of Alfonso XIII. Besides her struggles with the Carlists and others at home, Spain had to contend from 1868 to 1878, and again from 1895 onward, against insurgents in Cuba, where rebellion seemed almost the normal state of affairs. The United States intervened in 1898, and war ensued, resulting in the defeat of Spain, the almost complete destruction of her navy and the loss of her American and Asiatic colonies. (See UNITED STATES, WAR WITH SPAIN). The loss of the protected colonial markets greatly dislocated manufacturing interests, particularly in Catalonia, where the old separatist tendency is still strong. The year 1901 was marked by serious anti-clerical disturbances and the Sagasta government took a firm stand against the religious orders. The regency was terminated 17 May 1902 when Alphonse XIII came of age. In May 1906 the king married Princess Ena of Battenberg. In the same year the government sought to establish civil marriage and to regulate monastic establishments. Spain secured a rapprochement with France in 1904 by coming to an understanding with the latter in regard to Morocco; in 1908 both nations handled the Moroccan question in amity. The years 1908–09 were marked by anarchistic activities; a revolution was initiated at Barcelona which was soon suppressed and its leader, Francisco Ferrer, executed. In 1910–12 many internal reforms were instituted and Spain's relations with the Vatican placed on a more explicit basis. A measure of religious liberty to denominations other than Catholics was also enacted. Spain succeeded in maintaining her neutrality throughout the World War of 1914–18, although the feeling in Spain was sharply divided. The aristocracy and wealthy classes and a militaristic group sided with the Central powers, while the intellectuals and the great majority of the population took the part of France and the Entente. The Carlists were pro-German and the Republicans pro-Ally. Maura was against neutrality and publicly stated that Spain's interests would be best served by joining the Entente. This stirred the German element to action and a counter-campaign was instituted. The govermnent's position was rendered most difficult. The Romanones ministry fell early in 1917 and was succeeded by the Prieto ministry which lasted until 9 June 1917, when its fall was brought about by a crisis in the army, where a revolutionary movement developed. The Dato ministry partially succeeded in settling many of the points at issue and several reforms were instituted in the mode of army appointments, promotions, etc. The radical element demanded Parliamentary reform but met with little success. Strikes and disturbances became very numerous throughout the country in June and July 1917 and on 13 August it was announced that the government had decided to declare martial law throughout Spain. Garcia Prieto succeeded Dato as Premier on 3 Nov. 1917 and formed a compromise ministry from several factions in the Cortes. It lasted only a short time, having failed to allay the general dissatisfaction. A new Cortes met on 18 March and a new ministry under Maura was formed. It lasted until 9 Nov. 1918 when Romanones was asked to form a new cabinet. Within eight weeks Prieto was again at the head of affairs and Romanones was Foreign Minister. Great dissatisfaction was manifested with the attitude of the government toward Germany's submarine warfare; disorder was rife in the industrial regions of the kingdom. The Prieto ministry fell from power on 3 Dec. 1918.

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SPAIN, American Diplomatic Relations with. American relations with Spain, which have never been really cordial were largely influenced in the beginning by inherited traditions of Anglo-Spanish wars of two centuries.

In the Revolution, Spain withheld from alliance with the United States and in negotiations for peace planned to restrict the United States to territory east of the Appalachians. After 1783 she still hoped to obtain control of the trans-Appalachian west by restrictions on American commerce on the lower Mississippi and disputed with the United States the northern boundary of Florida concerning which the United States had a separate understanding with Great Britain. In 1795, however, she was induced to grant a deposit of American commerce at New Orleans and to recognize the American contention by agreeing to the northern Florida boundary at 31°.

In the two decades closing in 1815 Spain acted with France in the spoliation of American shipping, especially in the West Indies, resulting in later American claims for compensation. Another source of irritation and diplomatic negotiation arose from the secret transfer of Louisiana to France in 1801 and the later acquisition from France by the United States in 1803. In 1802 Jefferson offered to guarantee to Spain her trans-Mississippi territory for a cession of the island of New Orleans. After 1803 he claimed West Florida to the Perdido as a part of Louisiana, and by 1806 established a customs district therein in the face of Spanish protests. In 1810 the American government, under Madison, took possession of all West Florida which had declared its independence, and later extended jurisdiction farther east into territory over which Spain was unable to preserve order or to perform her international obligations.

In 1814, during the War of 1812 Jackson temporarily occupied Pensacola after driving out a British force which had occupied the place without the consent of the Spanish authorities. Later, in 1818, he again ignored Spanish sovereignty in this region by a defensive invasion which doubtless hastened the completion of negotiations which resulted in a treaty of 1819 (ratified 22 Feb. 1821) providing for acquisition of Florida by the United States and limits to Spanish western territory by a boundary established from the Sabine northward to the Red, up the Red to 100° longitude, thence north to the Arkansas and up the Arkansas to its head, thence north to 42° and thence west to the Pacific.

Still another source of friction was the revolt of the Spanish American provinces beginning in 1810, and resulting in a period of privateering in which American-built vessels illegally participated under the flags of the revolting governments. The American government recognized the revolted provinces as belligerents and sent special agents to report conditions, but maintained neutrality. Finally, in March 1822, after the ratification of the Florida treaty, it recognized the independence of four provinces (Mexico, Colombia, Buenos Aires and Chile) and in 1823 issued the Monroe Doctrine to prevent attempts of European powers, acting under the Holy Alliance, to aid Spain in efforts at resubjugation. Later it recognized Central America and Peru and, partly through fear of international complications relating to Cuba and Porto Rico, continued to urge Spain, both directly and indirectly through other European powers, to enter into peaceful relations with the new-born republics.

Cuba, whose destiny appeared uncertain, became the chief subject of diplomatic relations thereafter. A plan of guarantee of Cuba to Spain by the United States and other powers, first suggested by the American Minister (Forsyth) at Madrid early in 1822 as a possible compensation for Spanish recognition of Mexico and Colombia and adoption of a liberal system of commerce, was considered both at Washington and London in 1823. For two decades after 1825 American policy practically guaranteed to Spain the possession of the island on condition that it should not be ceded to France or England. In 1840 and 1843 the American government officially assured Spain of the American policy to maintain Spanish occupation of Cuba by American military and naval force against any attempt to wrest the territory from her.

The failure of the new American policy to purchase Cuba by diplomatic negotiations in 1848 was followed by a period of unsuccessful filibustering attempts (aided by lawless, adventurous Americans) to encourage revolt in the islands, resulting in various complications and new international suspicions. Declining to accede to an Anglo-French proposal of 1851 for joint action to prevent the landing of filibustering adventurers in Cuba, and also refusing to become a party to the later proposal of 1852 for a tripartite agreement disclaiming any purpose to obtain possession of Cuba, the American government under the Pierce administration, through the influence of slavery interests, adopted a systematic policy of annexation, illustrated in 1854 by the incidents of the *Black Warrior* episode and the Ostend Manifesto (repudiated by Secretary Marcy) and finally terminated only by the new issues of the Civil War period.

In the American Civil War, relations with Spain were largely concerned with the question of Confederate plans or operations, affecting Cuban neutrality, in relation to the use of the island as a base for enterprises endangering the American Union, and the Spanish occupation of San Domingo which the American government disapproved and which ceased in 1865.

Relations again became strained through conditions affecting American interests in Cuba and consequent diplomatic difficulties resulting from the Cuban Revolution of 1868–78. In 1869 President Grant contemplated the recognition of the Cubans as belligerents, and even favored intervention, but the American government limited its policy to presentation of complaints and demands and an offer of mediation to arrange a peace on a basis of Cuban independence. Relations reached a dangerous stage late in 1873 through American demands following the Spanish pursuit and capture of the *Virginius* on the high seas, and the execution of her captain and 53 of her crew at Santiago; but Spain finally yielded enough to secure an adjustment of the case. In November 1875 Secretary Fish, influenced by increasing difficulties which threatened to draw the United States into a war against Spain, confidentially sounded the chief European governments in regard to their views on a policy of foreign intervention in Cuban affairs.

After the pacification of Cuba in 1878, Spanish restrictive commercial regulations remained a continual source of complaint. The American government urged Spain to establish a more liberal government through independence or autonomy, to adopt a more liberal commercial policy and to secure better protection of American citizens and American property in Cuba. In 1884 and 1886 it obtained promises of the termination of discriminating and retaliatory duties, but the agreements were violated under various pretexts by the Cuban officials. In 1891 it was able to negotiate with Spain a reciprocity schedule under which American commerce was considerably increased in spite of the obstructions of Spanish officials in Cuba.

Three years later, the abrogation of this commercial arrangement injured the Cuban sugar industry and hastened the final devastating revolution of Cuba (in 1895), stimulated and aided by a Cuban junta in the United States and placing upon the American government a difficult problem of patrol to prevent filibustering while maintaining American rights. In 1896, embarrassed both by Cuban activities in the United States and Spanish treatment of American citizens in Cuba, the American government, under President Cleveland, made an offer of good offices for mediation which, however, was declined. It then gave warning that American forbearance has limits. In 1897, under President McKinley, it again used efforts to secure a peaceful solution of the difficulties.

Finally, after new sources of irritation culminating in the incident of the destruction of the *Maine* in Havana Harbor, it actively intervened in 1898 to terminate the intolerable conditions of Spanish rule in Cuba and to establish Cuban independence under an American protectorate. The resulting Spanish-American War was closed by peace negotiations through which Spain lost all her colonies in the West Indies and the Far East, and the United States obtained a stronger strategic position in the Gulf of Mexico and the Caribbean Sea besides the control of islands of the Pacific needed for coaling stations and suitable bases for exercise of a larger American influence in the Far East.

By treaty of 10 Dec. 1898, Spain relinquished sovereignty over Cuba, transferred Porto Rico and Guam as a result of conquest, and ceded the Philippines for $20,000,000.

A new treaty of friendship and general relations was concluded in July 1902 (proclaimed 20 April 1903). An international copyright agreement of 1895 was restored by interchange of notes 26 Nov. 1902, and an extradition treaty was concluded in June 1904 and (with a protocol of August 1917) proclaimed 21 May 1908. A commercial agreement for reciprocal tariff concessions, under the Tariff Act of 1897, was signed and exchanged in 1906, terminable in August 1910 by notice of the American government. An arbitration convention was concluded in April 1908, and extended by agreement of 1913. A new arbitration treaty was concluded in September 1914.

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SPALDING, Albert, American violinist: b. Chicago, 15 Aug. 1888. He studied under Jean Buitrago in New York, under Chiti at Florence and Lefort at Paris. He made his début at Paris in 1906 and achieved an immediate success. His later tours in France, Germany and England confirmed his reputation as an artist of signal ability. He made his American début in New York in 1908 and in the course of several seasons' work firmly established himself as a leading American violinist. He made many tours of the United States and Canada and also returned to Europe for a tour which extended through the leading European countries and into Egypt. In September 1917 he canceled his engagements for a concert tour of the United States and Canada in order to enter the United States Signal Corps, in which he received rank as lieutenant. Among his compositions are a set of variations for ‹My Old Kentucky Home› and ‹Concerto quasi fantasia› for piano and violin.

SPALDING, Albert Goodwill, American merchant, baseball player and official: b. Byron, Ill., 2 Sept. 1850; d. 9 Sept. 1915. As pitcher for the Boston Base Ball Club in 1871–75 he was one of the most famous base ball players of his day, his club retaining the championship for four successive seasons. In 1876–91 he was connected with the National Association Chicago Club, filling in turn the offices of manager, secretary and president. He also organized the National League. He was one of the founders in 1876 of the firm A. G. Spalding and Brothers, which became widely known as manufacturers of sporting goods. He lived at Point Loma, Cal., as a member of a theosophical colony from 1900 until his death. Author of ‹America's National Game› (1911).

SPALDING, Frederick Putnam, American civil engineer: b. Wysox, Pa., 7 April 1857. He was graduated from the School of Civil Engineering of Lehigh University in 1880 and after practising for several years was instructor in the university, 1886–88; assistant professor of civil engineering at Cornell, 1891–98, and has held a similar professorship in the University of Missouri since 1900. His publications include ‹Notes on Hydraulic Cement› (1893); ‹Text Book on Roads and Pavements› (1894);

‘Hydraulic Cement, Its Properties, Testing and Use’ (1897).

SPALDING, John Franklin, American Protestant Episcopal bishop: b. Belgrade, Me., 25 Aug. 1828; d. Erie, Pa., 9 March 1902. He was graduated from Bowdoin College in 1853, from the General Theological Seminary, New York, in 1857, and was ordained to the priesthood in 1858. He had charge of various parishes in Maine and Rhode Island in 1859–62 and was rector of Saint Paul's Church, Erie, Pa., in 1862–73. In the year last named he was consecrated first bishop of the missionary diocese of Colorado. He was an able and forceful organizer and an active promoter of advancement in education. His publications include ‘Modern Infidelity’ (1862); ‘The Higher Education of Women’ (1886); ‘The Church and its Apostolic Ministry’ (1887); ‘The Best Mode of Working a Parish’ (1888); ‘The Threefold Ministry of Christ’ (1887); ‘Jesus Christ the Proof of Christianity’ (1891), etc.

SPALDING, John Lancaster, Catholic prelate: b. Lebanon, Ky., 2 June 1840; d. Peoria, Ill., 25 Aug. 1916. His preliminary studies were pursued at Saint Mary's, Kentucky, and subsequently he attended Mount Saint Mary's, Emmitsburg, and Mount Saint Mary's, Cincinnati, afterward entering the American College at Louvain, Belgium, and being there ordained to the priesthood in 1863. He then devoted a year to special studies in Rome, Italy, and having returned to America, was assigned to duty in the cathedral of Louisville, Ky. In 1866 he was accorded the honor of preaching at the Second Plenary Council of Baltimore, a rare privilege for one so young, and despite many obstacles, he founded in Louisville a parish for negroes. Requested to be the biographer of his illustrious uncle, Archbishop Spalding, who died in 1872, Father Spalding repaired to New York for the purpose, and upon completing his labor of love, became assistant to Father Donnelly at Saint Michael's Church, New York, where he soon established a reputation as a preacher of extraordinary ability, being called thence to the episcopal dignity and consecrated first bishop of Peoria, Ill., in Saint Patrick's Cathedral, New York, 1 May 1877. He was associated with Archbishop Ireland in founding the Catholic Colonization Society, and in him higher Catholic education has had one of its most ardent promoters. Long before the Catholic University at Washington assumed material proportions, it had been conceived in the mind of Bishop Spalding, who was tireless in planning for its foundation; and the elaborate Catholic educational exhibit at the World's Columbian Exposition in Chicago in 1893, of which he was president, was prepared largely at his instigation. President Roosevelt appointed him one of the board of arbitration for the settlement of the great anthracite coal strike in 1902. Columbia University conferred upon him the degree of LL.D., in June 1902. Bishop Spalding was twice stricken with paralysis and failing to recover full vigor resigned his charge 10 Sept. 1908. In 1909 he was made titular archbishop of Scythopolis. His writings are among the most scholarly contributions to American literature, ‘Education and the Higher Life,’ ‘Things of the Mind,’ ‘Thoughts and Theories of Life and Education,’ ‘Opportunity and Other Essays,’ ‘Religion, Agnosticism and Education,’ ‘Socialism and Labor and Other Arguments’ and ‘Religion and Art, and Other Essays’ (1905), being some of the most notable of his works. Bishop Spalding is also the author of poems.

SPALDING, Martin John, American Roman Catholic archbishop: b. near Lebanon, Ky., 23 May 1810; d. Baltimore, Md., 7 Feb. 1872. He was educated at Saint Joseph's College, Bardstown, Ky., and at Rome, Italy, where he was ordained priest in 1834. He received charge of the cathedral at Bardstown upon his return to America and was also professor of philosophy in the seminary. He was president of Saint Joseph's College, Bardstown, in 1838–40. In 1844 he was appointed vicar-general at Louisville; and in February 1848 he became coadjutor bishop, while on 10 Sept. 1848 he was consecrated bishop of Lengone *in partibus*. He founded the American College at Louvain in 1857, and was installed as archbishop of Baltimore in 1864. Author of ‘Sketches of the Early Catholic Missions in Kentucky, 1787–1827’ (1846); ‘History of Protestant Reformation’ (2 vols., 1860), etc.

SPALLANZANI, späl-län-dzä'nē, **Lazzaro,** Italian naturalist: b. Scandiano, 12 Jan. 1729; d. 12 Feb. 1799. He studied at Reggio and afterward at Bologna, under Laura Bassi, the celebrated woman professor of physics in that place. In 1754 he was appointed teacher of logic, metaphysics and Greek at Reggio. In 1760 he accepted a professorship at Modena and on the reconstruction of the University of Pavia, in 1768, he was appointed to the chair of natural history there and thenceforth devoted himself to experimental researches and published in Italian various works on physiology, which made his name known through Europe. Among the subjects which engaged his attention were the phenomena of generation, the functions of respiration, digestion and the circulation of the blood. In opposition to the opinion of Buffon and Needham, he proved that the Infusoria are really endowed with animal life and not merely organic molecules. Among his writings may be cited ‘Experiments on Animal Reproduction’ (1786); on ‘Infusory Animalcules’; on the ‘Phenomena of Circulation’; on ‘Animal and Vegetable Physics’ (1780); ‘Transpiration of Plants.’

SPAN, a measure of length, being the distance between the tips of the thumb and little finger when the fingers are expanded to their fullest extent. This space averages about nine inches, which accordingly is the fixed measure given to the span. In architecture the term is applied to the width or opening of an arch.

SPAN-WORM. See MEASURING-WORM.

SPANDAU, spän'dow, Germany, in Prussia, a fortified town of Brandenburg, at the junction of the Spree and Havel, nine miles west-northwest of Berlin and now a suburb of that city. In the Julius tower of the citadel was deposited the reserve war fund of the empire — $30,000,000. The basis of this sum was the French indemnity paid in 1871. Here are large foundries and factories for all firearms, guns and all munitions of war, also a garrison of several thousand men. The principal buildings are churches, schools — including military schools for the different arms — artillery-construction bureau, factories for gunpowder, military and city hospital, etc. The fisheries and timber trade are important, also shipbuilding and horse and pigeon propagation for military purposes. The town was often the residence of the first electors of the house of Hohenzollern, and subsequently passed into Swedish hands — till 1634. In 1806 the French took possession and in 1813 was surrendered to the combined Prussian and Russian forces. Spandau is now the shipping centre for trade between Berlin and Hamburg. Pop. 84,855.

SPANDREL, or **SPANDRIL,** in architecture, an irregular space on a wall bounded by the outer curve of an arch and two lines meeting at right angles, the one drawn perpendicularly from the springing of the arch and the other horizontally from the apex, or by the outer curves of two contiguous arches and a horizontal line above them, or by similar curves of contiguous arches and the line of a larger arch enclosing the other two. This space, an approximate triangle, is excellent for decoration. It is sometimes decorated with figures in relief, as in the triumphal arches of Rome, or with medallions, as in many buildings of the Renaissance period. The term is also applied in engineering to the columns supporting the truss of a certain kind of steel-arched bridge, and also in the construction of a steel-skeleton building to the space between the top of a window and the sill of the next one above.

SPANGENBERG, spăng'ĕn-bĕrg, **Augustus Gottlieb,** German religionist: b. Klettenberg, Prussia, 15 July 1704; d. Berthelsdorf, Saxony, 18 Sept. 1792. He studied at Jena, abandoned law for theology, became a lecturer at the university and occasionally preached; in 1732 was made adjunct of the theological faculty at Halle and in 1733 was dismissed because of his doctrinal views. At once he entered the Moravian Church at Herrnhut and labored in Germany, America, the West Indies and England, where he established the Society for the Furtherance of the Gospel among the Heathen. After his consecration as bishop in 1744 he was at the head of the Moravian Church in America until his return to Europe in 1762. On his arrival in Germany he participated in framing the new constitution of the Church, of whose governing board he was the chief member. Among his works are 'Idea Fidei Fratrum' (1782; Eng. trans. by La Trobe, 'Exposition of Christian Doctrine,' 1784); and 'Leben des Grafen von Zinzendorf' (1775; abridged Eng. trans. by Jackson 1838). He also wrote some well-known hymns, such as 'Heil'ge Einfalt, Gnadenwunder' (Hymnal No. 432) and 'Die Kirche Christi, die Er geweiht' (Hymnal 612). Consult lives by Risler (1794); Ledderhose, K. F. (Heidelberg 1846; Eng. trans., London 1855); Knapp, G. C. (ed. by Otto Frick, Halle 1884), and Reichel, G. (Tübingen 1906).

SPANIEL, a small shaggy race of dogs, deriving its name from Spain, whence it originally came to Great Britain, and now generally divided into the two groups — sporting and toy spaniels. The common "field" spaniel is the type of the group and two breeds of this variety, "springer" and "cocker," are distinguished. The former is a heavy dog used for beating game in thick coverts. The spaniel has the hair very long in some parts; it is generally white, with large brown, liver-colored or black spots, of irregular shape and size; the nose is sometimes cleft; the ears are very long and pendulous and covered with long hair. The tail is feathery and waves from side to side when the dog runs. Two famous breeds of springer spaniels are the black Sussex and the larger Clumber breed is also well known. The cocker, whose name recalls its former use in English woodcock shooting, is much smaller than the field spaniel. The best-known breeds of the latter form are the English, Welsh and Devonshire varieties. The smaller, King (or Prince) Charles spaniel, is a small variety of the spaniel, used as a lap-dag. It is sometimes found entirely black, and receives its name from the liking of Charles II for this variety. The Blenheim breed is of smaller size than the King Charles variety, and is bred merely as a pet. Its hair is long and silky, and does not curl; the ears are long, and provided with the same silky hair; the legs are covered with this hair to the toes; and the tail possesses a broad hairy fringe. The water-spaniels are dogs of moderate size, and average about 22 inches in height at the shoulders, and the ears are very long and pendulous. The Japanese pug-nosed spaniel, Maltese and other toy-breeds may be added to this list. See DOG.

SPANISH-AMERICAN ATHENÆUM. This organization was established in Washington, D. C., in 1913 by Bishop Charles Warren Currier, Francisco J. Yanes, Dr. James Brown Scott and J. Moreno Lacalle. Its purpose is to develop and disseminate in the United States interest in the literature and history of Spain and the Spanish-American republics. Monthly meetings are held with programs contributed by diplomats, educators and travelers. One number of its "Revista" has been published. Present officers are Guillermo A. Sherwell, of Mexico, president, N. H. Darton, of Washington, vice-president, Dr. Luis Churion of Venezuela, second vice-president, Wm. T. Faulkner, secretary-general. Alfonzo XIII, king of Spain, is the honorary president.

SPANISH-AMERICAN LITERATURE. See LATIN-AMERICAN LITERATURE.

SPANISH-AMERICAN WAR. See UNITED STATES, THE WAR WITH SPAIN.

SPANISH-AMERICAN WAR, The Naval and Military Order of, an association organized in New York, 2 Feb. 1899. Its objects are to cherish the memories and associations of the war. There are State branch associations in Pennsylvania, Massachusetts and Illinois. The total membership in 1903 was 1,100.

SPANISH ART. At the beginning of any profound study of the greatest of the Spanish paintings, which were those of the 17th century, should stand the fact, the true significance of which has hitherto been overlooked by art critics, that the production of the famous ironwork of Spain trained eye and hand — taught marvelous celerity and certainty of execution — through many centuries that preceded the 17th. The Moors had expressed, with iron as a medium, not only their basic principles of design, but also the delicate and elaborate method they applied to the precious metals.

During the Romanesque and early Gothic periods French ironwork also exerted its influence in the western peninsula. Afterward, Italian Renaissance architecture, as it was interpreted and applied in Spain, gave to the ironworker such an opportunity for the exercise of his talent that he achieved grandeur and architectonic quality in his work, surpassing the attainments of iron-masters in other lands; and, if we are to appreciate the distinguishing characteristics of such pictures as the 'Spinners' and the 'Meninas,' painted after the manner of an instantaneous photograph, we must remember that the artistic ironworker was generally an expert in other arts as well, and sometimes the ancestor of a painter who thus inherited, as did Velasquez, for example, rapidity with certainty of execution, power in combination with delicacy. In this connection we may cite the following characterization of the Gothic and Renaissance ironwork: "The charm of the Gothic cannot be denied. Produced, as it were, by feverish, powerful blows delivered during the brief moment that the mass was glowing hot, it is a sort of solidified impressionism and appeals accordingly. This mediæval spontaneity, it is true, eluded the more sophisticated Renaissance worker; but not the mediæval craftsmanship. This he retained and added to by his command of newer processes and his greater knowledge of design till he had reduced the mightiest of all metals to an obedience that would have been unbelievable to his predecessors." (Consult Byne, A., and Stapley, M., 'Rejería of the Spanish Renaissance,' New York 1914, and 'Spanish Ironwork,' ib. 1915; also 'The Famous Ironwork of Spain' in the *Architectural Record*, Vol. XXXIX, ib. 1916). We shall again refer to this potent influence when we come to the third and universally significant period of Spanish painting.

Painters, Architects and Sculptors.— The attempt to trace clear national lines of development in the Spanish arts has always been regarded — and not without reason — as an extremely difficult undertaking. Spanish art is indeed like a river whose current is swollen by many a stream from as many different lands. Nevertheless it has characteristics that are strikingly — often startlingly — individual and distinctive, and these are the characteristics to which we should devote special attention. The difficulty just referred to has been increased and intensified by the undue attention that writers have paid to the numerous foreign artists who have been residents in Spain and whose works still remain there: to those foreigners who, in Spain but not sympathetically of Spain, neglected or failed to express, in and through the works of art they created, the Iberianism of the country that sheltered them and employed their talents. It has seemed to us necessary, therefore, to prepare a new list of Spanish painters, architects and sculptors, which should be based upon an independent principle of selection. We omit the names of all who do not seem to be more closely connected with the Spanish arts than with those of any other country.

Here follows the list, designedly restrained within very narrow limits and presenting the names of painters, architects and sculptors in alphabetical order: Bayeu, F., painter, 1734–95, worked at Zaragoza, Madrid, Toledo, etc.; Becerra, G., sculptor, b. 1520 at Baeza, d. 1570 at Madrid, worked at Burgos, Astorga, Salamanca, etc.; Berruguete, A., son of the court-painter Pedro, sculptor, architect and painter, c. 1480–1561, worked at Avila, Valladolid, Salamanca and Toledo; Cano, A., painter, sculptor, architect, 1601–67, worked principally at Granada and Seville; Churriguera, J., architect and sculptor, late 17th century to 1725, worked at Madrid and elsewhere, and was succeeded by his sons Gerónimo and Nicolas; Espinosa, J. J. de, Valencian painter, 1600–80; Falcó, N., Valencian painter, worked c. 1515–76; Forment, D., sculptor, worked at Huesca and Zaragoza, c. 1511–33; Gallegos, F., painter, c. 1465 or 1475–1550, worked at Salamanca and Zamora; Goya, F. de, painter, 1746–1828, worked at Zaragoza, Valencia, Madrid and Bordeaux; Greco, El (see THEOTOCÓPULI, D.); Hernandez, G., sculptor, 1566–1636, worked at Valladolid and Plasencia; Herrera, F. (el Mozo), painter, 1622–85, worked at Seville and Madrid, and Herrera, F. (el Viejo), 1576–1656, painter, who also worked at Seville and Madrid; Herrera, J. de, 1530–97, architect of the Escorial; Leocadio, P. de (San Leocadio), Valencian painter, 16th century; Mazo, J. B. del, Velasquez's son-in-law and pupil, d. 1687; Mora, J. de, 1638–1725, sculptor; Murillo, B. E., painter, 1617–82, worked at Seville; Pacheco, F., 1571–1654, painter, instructor and father-in-law of Velasquez, worked at Seville and Madrid; Pantoja de la Cruz, J., 1551–1610, court painter to Philip II; Ribalta, F., c. 1551–1628, painter, worked at Valencia; Ribera, J. de (Lo Spagnoletto), 1588–1656, painter, worked at Valencia and Naples; Rincón, A. del, c. 1446–1500, court painter to Ferdinand and Isabella; Roelas, J. de las, 1558–1625, painter, worked at Seville; Sánchez Coello, A., d. 1590, court painter to Charles V and Philip II; Sorolla y Bastida, painter, b. Valencia 1863, lives there and in Madrid; Theotocópuli, D., pupil of Titian, painter, sculptor, architect, called El Greco because born in Crete at an uncertain date, worked at Toledo and died there at an advanced age in 1614; Valdés Leal, J., 1630–91, painter, worked at Seville; Vargas, L. de, 1502–68, painter, worked at Seville; Velasquez (or Velazquez), Diego de Silva, 1599–1660, painter, studied first at Seville, afterward identified with the Spanish court and court-circle of Philip IV at Madrid and elsewhere; Viladomat, A., 1678–1755, painter, worked at Barcelona and Tarragona; Zarcillo, F., 1707–48, sculptor, worked at Murcia; Zuloaga, I., painter, b. Eibar, 1870, lives chiefly at Segovia; Zurbarán, F., 1598–1662, painter, worked at Seville.

The names of other Spanish artists, whose works exemplify special tendencies rather than the main lines of growth or the distinctive Iberian characteristics, will be mentioned — with comment whenever that is required to differentiate their talents — in the following paragraphs.

Spanish Painting.— The history of Spanish painting falls into three main periods: First, the period of the Flemish influence; second, the period of the Italian influence; and third, the period in which the Spanish genius "found itself," gaining vastly in the power of independent art-expression, and so, with creative art-impulses freed in a measure from bondage to foreign schools, though never wholly escaping the tyranny of national institutions, political, religious and social, finally acquired, as we said above, universal significance. About the end of the 15th century or the beginning of the 16th, the works of Antonio del Rincón at Granada and the panels of Fernando Gallegos at Salamanca and Zamora, as well as the easel-paintings and panels of the early Seville painters, Juan Sánchez de Castro and Alejo Fernandez, most clearly proclaim the northern influences still triumphant throughout the peninsula, as they had been continuously, except along the northeastern littoral and in the extreme south, ever since 1435 or 1440. But the irresistible charm of the great Florentine masters was presently to be felt in Spain as in western Europe generally. A new world of artistic possibilities was revealed to Spanish art-students voyaging eastward just when Spanish soldiers and merchant-adventurers, year after year sailing westward, were engaged in exploring and conquering the New World of boundless material possibilities; and so, at this point in our study, we come upon a half-century of inspiring, fancy-stirring Spanish experiences — of a synchronous hazard of new fortunes in art and imperial expansion, in Italy and America. By the middle of the century, or just a little while afterward, the oceans and mountains, the rivers and «naked lands» had been explored, and that fever of daring ventures abated. By the middle of the century, or a little before, the methods and aims and almost — not quite — the heart of the Italian Renaissance had also been explored; and by an altogether dramatic coincidence Seville, rather than any other Spanish city, received Italy's new message, and more than the other cities appreciated it, at the very time when she was receiving at her Tower of Gold all the amazing shipments of America's treasure.

Somewhat before the days of Luis de Vargas, the Italian influence became potent at Seville, and for more than two generations, or until the close of the useful career of Francisco Pacheco, its control was not seriously contested except by Juan de las Roelas and Francisco Herrera the elder. In central Spain, meanwhile, the successors of Alonso Berruguete strove to pass from hand to hand the torch their distinguished master had kindled at the cinquecento flame, but here the efforts appear to have lacked continuity and organization. At the Spanish court the northern tradition was still far from being dislodged: to prove this a glance at scrupulously conservative portraits painted by Alonso Sánchez Coello and Pantoja de la Cruz will be sufficient. Nevertheless the court was already attentive to the appeal of Italian painting — in this instance not the Tuscan but the Venetian school. The superb collection of Venetian pictures at Madrid, begun by Charles V and increased by Philip II, made that appeal, which became a resistless one when it had thus gained the compelling force of propinquity.

Now, the Renaissance spirit itself bespoke a freer quest of beauty than had ever before been conceded by Spanish realism; but the situation called for an apostle of freedom — and El Greco came. Domenico Theotocópuli (El Greco), by the independent character of his work at Toledo, by the originality he probably advocated and certainly exemplified with wonderful success, suggested to other painters, as a not unattainable ideal, the expression of personality without slavish dependence upon any foreign school whatever in the manner of its expression. As a zealous advocate of religious and social reforms speaks, often overemphasizing his «values» in order to convince his audience, so El Greco painted, often forgetting mere truth to nature; but fortunately the early training at Venice gave him that command of color and fluency in narration that are in evidence even at such moments — perhaps especially at such moments. And of course the Venetian training counted in his favor and in favor of the acceptance of his novel theories by many Spaniards. The reason why such acceptance had become possible has been plainly stated in the two foregoing paragraphs. In Seville we find at almost the same time the progressive Juan de las Roelas and a bit later that declarant of independence, the elder Herrera, as above intimated. In Valencia the Italianized Francisco Ribalta was the teacher of Jacinto Jerónimo de Espinosa, who displayed independence in the choice of some of his themes. Ribalta also, it is much more important to note, was probably the first instructor of that exceptional painter whose great talent embraced the best characteristics of both Spain and Italy, Jusepe de Ribera, called Lo Spagnoletto. It is not too much to say that Ribera added constructive reality to Theotocópuli's inspiring but vague theories and ideals of freedom and the free expression of personality. The Toledan has predisposed; now Ribera disposed, showing to all the definite, sure path that led to greatness through the ennoblement, not through the abandonment, of the realistic bias — of the national propensity toward realism. And so we place together the names El Greco and Lo Spagnoletto. The Greek said: «Find a way.» The Little Spaniard said: «This is the way.» Together, in this sense, they usher in the third period.

Estremadura gave to Spain and the world Francisco Zurbarán, realist, unequaled portrayer of monastic types; Córdova, a number of naturalistic painters. To the latter school belonged Antonio de Saavedra y Castillo and his pupil Juan de Valdés Leal (afterward identified with the school of Seville). Especially representative of the school of Granada at the beginning of this period are Alonso Cano (who had previously devoted his attention to sculpture at Seville) and his two pupils — or, it may be, only his most able immediate successors — Juan de Sevilla and Fray Atanasio, surnamed Bocanegra. But the school of Seville gave to Spain and to the world Bartolomé Esteban Murillo and Diego Velazquez, or Velasquez. (The latter signed his own name — and distinctly enough — in 1650 *D.D.*, that is, Diego de Silva, *Velasquez*. His mother's family name was Velázquez, but he substituted *s* for the first *z* at that time).

For our present purpose it is less essential to describe Murillo and Velasquez as the greatest of Spanish painters than to realize how differently they were affected by the 17th century influences at Seville — the new movement favoring freedom in choice of subject and realism in its treatment, while the old repressive ecclesiastical policy discouraged such freedom. Two striking passages in Mr. Tyler's book (see *Bibliography*) show that writer's clear apprehension of the dissimilar manifestations: «There [in Seville] sat Pacheco, appointed censor by the Inquisition, proclaiming that the one aim of art was to excite men to devotion. . . . Murillo seems to have had a temperament that naturally expressed itself through pious subjects; thus there was nothing in the air of Seville that made it stifling for him. But what of men like Herrera el Mozo and Valdés Leal? They both had detestable characters and great aptitude, especially the latter; but 17th century Seville, which was so pleasant to Zurbarán and Murillo, drove them to every sort of bitter excess.» And again, the turning-point in the career of the school «was reached when the twenty-year-old Velazquez went to Madrid. Though his master Pacheco was a pedant, he seems to have been a friend to art after his own manner, and there were enough painters in the Andalusian capital to have kept a brilliant school alive, had it not been for the exaggerated atmosphere of devotion that prevailed there. Whether Velazquez would have become the man we know had he stayed there instead of travelling in Italy is open to grave doubts; at any rate the atmosphere of Seville was too close for him. He went to court, and those who stayed had to devote themselves to religious subjects or starve. Velazquez was able to paint as he pleased at Madrid.» Professor Carl Justi has made the correct observation that Murillo was originally as essentially a realist as Velazquez; but for the simple reason that he continued to live in a Roman Catholic provincial town and painted for conventual churches, he «had to represent the subjects that pleased the devout of his day, such as the Immaculate Conception, the visions of the monk's cell, the mysteries and ecstasies of asceticism. He could not devote his entire energy to the reproduction of the mere visual phenomena. He had to depict what was never seen. . . . His artistic greatness, the secret of his wonderful success, lies in the fact that he recognized the unique character and special charm of the human nature of southern Spain, adapted it to the palette and the brush, and ventured to introduce it into paintings of religious subjects.» Velasquez, after wrenching himself free from provincialism, discovered in himself the very special powers of another Cristóbal Andino, that greatest and most honored 16th century ironworker of Burgos, Seville and Toledo. Let us read what was written by Bonnat in his preface to Beruete's 'Velazquez' (see *Bibliography*): «The methods which Velazquez employed to obtain such startling results are surprisingly simple. Armed with a palette on which only a strictly limited number of colors appear, and with a few long and slender brushes in his hand, he painted in everything at the first touch. The shadows, much simplified, are merely rubbed in, and only the high lights are thickly painted; and the whole, with its fine gradations of tone, is so broadly and rapidly executed, and is so precise in color and proportion, so exact in its values, and so true in drawing, that the illusion is complete and the resulting work a marvel.» Yet it is only proper to say that Bonnat, so far as we know, had not given thought to the analogue or explanation that we have offered. At Madrid, the contemporaries of Velazquez, forming the Madrid School, were Fray Juan Rizi (1595–1675); Antonio Pereda (1599–1669); Francisco Rizi (1608–85); Juan Carreño (1614–85), Velasquez's successor as court-painter; José Leonardo (1616–56), and Diego Polo (1620–55). A little later came Juan Antonio Escalante (1630–70); Mateo Cerezo (1635–75); José Antolinez (1639–76); Claudio Cœllo (c. 1630 or 1635–93), and Sebastian Muñoz (1650–90). The capital, with its collections of paintings for study, with its more liberal patronage and interesting life, became the centre of artistic activity by 1625 and retained that preeminence to the end of the 17th century.

During the greater part of the 18th century Spanish art produced imitations. Señor Beruete y Moret (see *Bibliography*) even goes so far as to say it produced «nothing but imitations,» then adding that «these imitations were not particularly happy.» Original talent was temporarily displaced — that was all; for it was reinstated by Goya (1746–1828) whose works, taken all together, make a remarkably vivid and complete picture of the Spanish life of his day. «In the latter years of the century,» writes Señor Beruete y Moret, «an original artist, Francisco Goya, arose. He cast from him all foreign influence and realized an art of his own which was so genial, so characteristic, and so Spanish that it gave evidence of the renascent artistic spirit of his country.» True, that promise of renascent Iberianism was not quite fulfilled in the works of José de Madrazo (1781–1859), Federigo de Madrazo (1815–94), Mariano Fortuny (1839–74), or José Villegas, b. 1848; but Sorolla (Joaquin Sorolla y Bastida, b. Valencia, 1863) depicts very brilliantly the sunlit atmosphere of his native province, while Ignacio Zuloaga (b. Eibar, 1870) summons the Spanish people and landscapes to appear on his canvases as though he were a magician. Zuloaga's talent exemplifies the obligation of Spanish painting to Spanish metalwork. His birthplace, the Basque town of Eibar, is called the «Toledo of the North» because the occupation of its people is to temper and damascene sword-blades and poignards. His great-great-grandfather, Don Blas Zuloaga, was an excellent armorer and a friend of Goya; his grandfather, Eusebio, also a famous armorer, organized and directed the Royal Armory at Madrid; his father, Plácido Zuloaga, revived the art of inlaying metals. Consult Frenzi, G. de, 'Ignacio Zuloaga' (Rome 1912).

Architecture.— The best single point at which one can subject works of architecture of all the Spanish architectural periods to direct and personal observation is undoubtedly the ancient city of Toledo, since all such periods are represented in its structures, and represented by good examples. But Mérida in the southwest possesses the most interesting architectural memorials of the Roman Empire, as Asturia in the north possess those of the Visigoths. During the Roman period imperial public buildings were very numerous in Spain; and although comparatively few escaped destruction their massive dimensions and characteristic lines exerted an influence in the formation of national taste that has never been wholly lost. Again, between 414 and 711 (the Visigothic period) another controlling influence was felt; and this is far from being unworthy of our consideration, inasmuch as, among all the hordes that invaded Spain in the 5th century, the Visigoths, natives of Dacia, the modern Rumania, were, as Mr. Tyler says, already Christians, and by far the most advanced in the arts of war and peace. Mr. C. H. Blackall writes (in Sturgis, R., 'A Dictionary of Architecture and Buildings,' New York and London 1905) that the invasion of the Visigoths appears to have swept away nearly all the architecture of the Roman period, while the conquest by the Moors, in the early part of the 8th century, in its turn obliterated most of the remains of the Visigothic work, except in the north. Then, «the seat of government being fixed about Madrid, the Renaissance style, which was imported from Italy and fostered by constant intercourse with foreign artists, was naturally at its best on the central plateau.» In the central portion much of the mediæval work «disappeared to make room for the Renaissance palaces. In the south the Moors found little to preserve when they first entered the kingdom,» and the architectural work that they themselves did was of such manifest value that it was, on the whole, very little disturbed subsequently. We, therefore, find the Gothic and Romanesque chiefly in the north, the Moorish in the south and the neoclassic along the central plateau.

The mosque at Córdova, the oldest and largest Moorish monument in Spain, founded in 785; El Cristo de la Luz at Toledo, and in the same city the Casa de Mesa and the Taller del Moro; the Giralda tower (1196) at Seville; the Alhambra at Granada — these are familiar examples of Moorish work before the reconquest. The name Mudéjar is given to that blending of the Christian and Moorish styles which took place after the reconquest. The Romanesque, introduced toward the end of the 11th century, prevailed throughout the 12th. Examples of this are, beside that famous resort of pilgrims in our own day, the church of Santiago de Compostela (1060–96),— Sant' Isidro in León (1063–1149), San Pedro at Huesca (1100–1241) and the cathedral of Lugo (1129–70). Not long afterward the Gothic was introduced from France, and as examples we may mention the churches of Viruela and of Las Huelgas, the latter built by Ferdinand III about the middle of the 13th century. But the Gothic at first failed to maintain itself as French-Gothic in Spain: it became Spanish-Gothic, actually composite, by the union in the same structure of the new Gothic principles with the Romanesque, or those of a still older period. Such are the churches of Salamanca (1178) and Santa Maria at Benavente (1170–1220). Not before the 13th century could the pure, perfected French cathedral style make an irresistible appeal. It was adopted and magnificently shown then in the cathedrals of Burgos (1221), of Toledo (1227), and of León (1250–1305). The cathedral at Seville, largest of all Gothic churches, was founded at the beginning of the 15th century. The end of the same century witnessed the erection of buildings of extraordinary originality and picturesque charm which, as Professor Carl Justi writes, «mirror that mighty outburst of national feeling which followed in the train of a series of unparalleled events.» Noteworthy among the structures of this group are the façades of San Gregorio and San Pablo at Valladolid and of Santa Cruz at Segovia.

The Renaissance came to Spain almost a century later than to Italy. Here «the essential point of contact was in the domain of decoration; artistic imagination, accustomed to Mudéjar and Gothic ornamentation recognized in the new style a new class of motives, enlarging its previous range.» An important example is the coro of the cathedral of Córdova, although this had been begun in 1523 in the Gothic style. So suggestive of works in the precious metals was the new manner of ornamentation that the term Plateresque (from *platero,* meaning silversmith) was given to it. An honored name among architects at the time was that of Diego de Riaño (d. 1533), who designed the Sevillan city hall and portions of the cathedral; representatives of a reaction in favor of severity and restraint, advocating the attainment of more stately effects through proportion alone, without decoration, were Juan de Toledo, who began the Escorial, and Juan de Herrera, who completed that huge late-Renaissance structure. In the 18th century the Churrigueresque, a style peculiar to Spain and Spanish colonies, ran riot (see CHURRIGUERA in foregoing list of painters, architects and sculptors) and the canons of classic design were disregarded. «Stucco and gilding were lavishly used,» says Sturgis, «and broken pediments, twisted shafts and contorted scrolls abound. The result is, like nearly all Spanish work, highly decorative and not without a certain theatrical splendor, but it lacks structural reasonableness. About 1750 a more academic style began to displace the Churrigueresque.» Best of the 18th century «more academic» buildings is the Royal Palace at Madrid, a dignified and well-balanced composition. In the 19th century and thus far in the 20th, eclecticism has been the rule. It has seemed the part of wisdom, in a country so rich in varied traditions of art, to reproduce approved old forms rather than minister to the craving for novelty.

Sculpture.— In the Renaissance period the Italian influence was overwhelming and during many years the marble-cutters of the better class were almost exclusively natives of Italy. This circumstance has occasioned general acceptance of the theory that, during earlier and later periods as well, this or that foreign influence usurped the place lawfully belonging to original Spanish talent. We shall try to indicate the correct limitations of such a theory, in the course of a brief review of the main essential facts.

And first we must realize that native works of great merit, such as those of Pedro of Tarragona in the Tarragon Cathedral, date from 1426, 1434 and so on; that Bartolomé's *apostles* at the main door of the same cathedral date from 1278; and that the Apostles' Door at the cathedral of Burgos was also executed in the 13th century. In other words, Spain did not wait for the coming of the Italian Renaissance, or for its long-delayed arrival at her shores (end of the 15th century), but on the contrary created ideal figures, portrait statues and whatever was required for the embellishment of architectural design, long before Italianization prevailed. French influences are evident in some of the sculptures of the 13th and 14th centuries; Netherlandish influences in some of those of the 15th century. But an art critic should not fail to observe the relatively small number of those sculptures which belong to the schools mentioned and may properly be called foreign products. He will perceive Spanish realism, with its directness and forcefulness of expression, stamping as Iberian the vast majority of early sculptures, down to or even beyond the middle of the 15th century. Gil de Siloe, toward the end of that century, produced such sculptures as the monument in honor of Bishop Alonso de Cartagena at Burgos and the well-known works at Palencia and in the Cartuja de Miraflores. A few years afterward, however, the supremacy of Italian sculpture was recognized. Bartolomé Ordóñez frankly employed Italian assistants, and was working with them at Carrara when he died (1520). Alonso Berruguete, who returned from Italy in the year of Ordóñez' death, was a versatile artist whose impulse, on rare occasions, to regain originality led to extravagances; but his chief work (if we accept Professor Justi's view to this extent) «shows how deeply he had steeped himself in the spirit of Michelangelo.» Damian Forment and Diego Morlanes were inspired by Italian and classic ideals.

The period of complete emancipation arrived when Spanish sculptors chose wood as a convenient substitute for stone — a period or epoch during which was accomplished a revolution in ecclesiastical taste that is peculiar to Spain. The enthusiasm for figure sculpture grew into a marked predilection for bulk and multiplicity of detail; and «one result of this was that stone-carving was practically abandoned, and the artist confined himself almost exclusively to wood (pine, cedar, linden, larch) as a cheaper and more easily worked material. Coloring was not used at first. Now arose those huge retablos which cover a choir-wall reaching up to the vaulting with a Jacob's Ladder of statues. All that had been expressed in the 14th and 15th centuries by small painted groups and panels was now translated into lifesize statues.» Miguel de Ancheta made a retablo containing 35 statues and groups. Gaspar Becerra was one of the most famous sculptors (in this medium) among Castilians. In Seville, at the beginning of the 17th century, Martinez Montañéz, in whose works there is not a trace of the Italian style, or indeed of any other foreign influence, led popular interest in and appreciation of polychrome sculptures, whose art is «the result of an essentially Spanish attitude of mind, while the sense of form through which it is expressed is probably peculiar to Seville.» The polychrome figures did not, however, represent the best achievements in this distinctively Spanish phase. Pedro de Mena, a sculptor of Granada in the last half of the 17th century, carved statues and statuettes that required no paint to enhance verisimilitude. The unpainted small wooden figures of saints by this artist are remarkably original, as all critics will admit. But they show more than independence of foreign schools: they show such marked superiority that foreign students of art may learn the fine secret of true characterization by visiting the cathedral at Malaga and copying Mena's sculpture there.

It seems to us that the story of enfranchised Spanish sculpture — often wholly or in a measure free and sometimes lawless, ungovernably Iberian, as in the days of Churriguera and those of Francisco Zarcillo (1707–48), Arismendi, and Ron — reaches its true climax when Mena's success is recorded. A classic reaction of no genetic value at the beginning of the last century resembled what took place in France at the same time. The present century witnesses reassertion of the national tradition, in this art as in the art of painting, and now looks for an exponent of Spanish realism who, as sculptor, shall stand beside the painter, Ignacio Zuloaga.

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MARRION WILCOX.

SPANISH BROOM, a leguminous papilionaceous shrub (*Spartium junceum*), a «switch plant,» characterized by bunches of rod-like branches, terete, polished and green. The branches are without foliage, serving as organs of assimilation; or they may have small lancet-shaped leaves, scantily developed and quickly falling. The Spanish broom is native to the Mediterranean shores, where it grows in masses, as may be seen on Gibraltar, on dry and rocky ground. It has been naturalized in tropical America, and cultivated for the terminal racemes of large pea-like flowers. These are an inch long, golden yellow and very fragrant, with the odor of acacia, and are a favorite food of bees. They also yield a yellow dye. The tough twigs are used as food for goats, and produce a coarse fibre; the seeds, from linear pubescent pods, are diuretic and tonic and in larger doses emetic and carthartic.

SPANISH ERA. See EPOCH.

SPANISH-FLY. See BLISTER-BEETLE.

SPANISH FORT, a part of the defenses of the city of Mobile, Ala., during the Civil War; taken by the Federals 8 April 1865. It consisted of a system of fortifications, rather than a single fort. On 27 March it was invested by Union troops, A. J. Smith's corps, on the right, and Granger's on the left; a bombardment was begun 4 April, in which the gunboats on the river joined, and a naval battery on shore rendered service. The Federals intended to assault the defenses on 9 April; but on the 8th General Carr found that it was possible to place a battery on a wooded crest commanding the fort and that evening his troops gained the crest, captured 300 yards of the works and, getting their battery into position, compelled the Confederates to evacuate. Consult ‘Battles and Leaders of the Civil War’ (Vol. IV).

SPANISH FOWLS. See Poultry.

SPANISH LANGUAGE, The. Spanish is one of the modern spoken and written forms of Latin, that is, it is a neo-Latin or Romance language. Its motherland is Spain in the Iberian Peninsula. Besides Spanish two sister Romance tongues are in use in the peninsula, viz., in the western part, Portuguese (which is never to be regarded as a dialect of Spanish), and, in the eastern part, Catalan (which has affinities to the Provençal of southern France). In part of northern Spain and in the district of the Pyrenees the native speech is Basque, which has no discernible relationship to its neo-Latin neighbors, Spanish and French, and is thought by some to be a survival of the ancient Iberian language. In Galicia, which occupies the northwestern corner of Spanish territory, the natural idiom is Galician, and it is a dialect of Portuguese. In the Middle Ages both Catalan and Galician had literary manifestations of no little importance. In spite of school influence, which tends to spread the influence of Castilian to their detriment, they continue to be the popular spoken languages of their districts, and Catalan has continued to have its notable writers of both prose and verse down into our own times.

In the strictly Spanish-speaking region three dialectal divisions are marked, viz., (1) Castilian-Andalusian in the centre and south of the land, (2) Leonese-Asturian in the west and north, and (3) Navarro-Aragonese in the northeast and east. Through political importance and as a result of various other reasons, especially the greater activity of its writers in the earlier period, Castilian soon became the dominant form of Spanish and remains such to-day. The term «Castilian» is often used as the equivalent of «Spanish» to designate both the language and the literature. Some have regarded Andalusian as an individual dialect, but it differs so little from Castilian — one of its most distinctive traits is its assibilation of *c* (before *e* and *i*) and of *z*, which Castilians pronounce as voiceless interdental *th* — that there is little need of giving it a place apart. For literary purposes the Navarro-Aragonese and the Leonese-Asturian have never received any extensive or lasting development.

The following may serve to illustrate some of the phonological differences between the two dialects and the standard Castilian. They both have a glide-sound between *e* and a following vowel, where Castilian has none: *leyer*, «to read,» Cast., *leer; leyal,* «loyal,» Cast., *leal.* They both have palatalized *ll* (the *li* of English «*filial*» approximates to this sound) where Castilian has a j (a guttural spirant; cf. the Scotch *ch* in «loch»); *fillo,* «son,» Cast., *hijo; ovella,* «sheep,» Cast., *oveja.* They both have *it* where Castilian has *ch: dereito,* «right,» Cast., *derecho; muito,* «much,» Cast., *mucho.* The both develop diphthongs out of accented Latin short *ĕ* and *ŏ*, where Castilian fails to do so (because of the influence in Castilian of a following palatal): *pueyo,* «height»; Cast., *poyo;* Latin *pŏdium: fuello,* «leaf»; Cast., *hoja;* Latin pl., *folia,* etc. Leonese changes *l* after a consonant to *r: branco,* «white,» Cast., *blanco.* Aragonese keeps initial Latin *pl* and *cl* where Castilian changes them to *ll: plorar,* «to weep,» Cast., *llorar; clamar,* «to call,» Cast. *llamar.*

In morphology the dialects have also certain traits that distinguish them from Castilian. Thus Aragonese tends to create a feminine form in *-a* for adjectives which are not entitled historically to that ending: *doliente,* «grieving,» fem., *dolienta,* Cast., *doliente* for both genders. Leonese uses fuller forms of the definite articles: *el, ela, elos, elas:* cf. Cast., *el, la, los, las.* Leonese has *-er* infinitives where Castilian has *-ir: viver,* «to live,» *dizer,* «to say,» Cast., *vivir, decir.* Castilian has no separate possessive form for the plural possessive «their,» but uses *su, sus,* which also means «his,» «her,» etc.; Aragonese uses *lur, lures* (cf. French *leur, leurs*) as a distinctive form for «their.»

By colonization and conquest Spanish has been carried to foreign regions. The explorers and settlers took it to the New World, where it is now used by hardly fewer than 50,000,000 of persons in the western continent and adjacent islands, from Mexico southward. For that matter it is still spoken even in tracts of the United States, e.g., in New Mexico, California, Texas, etc. It followed the Spanish flag to the Canaries and the Philippines, without, however, displacing the aboriginal speech in the Philippines any more than it has done so in the parts of America in which the Indians are numerous. In Spanish America the pronunciation reveals traits that once existed in Castilian of the 15th and 16th centuries and have since changed in the motherland, and it shows also features of the dialects of the portions of the peninsula whence the settlers came. But to all intents and purposes, since the dialectal differences operate for only a restricted number of sounds and the accepted principles of grammar are those of Castilian, the Spanish of Spanish-America is properly enough denominated by the generic, if somewhat elastic, term of «Castilian.» The expatriated Moors and Jews have taken Spanish to places in northern Africa and in Turkey, where they still speak it in a more or less contaminated form. It is safe to say that in the neighborhood of 70,000,000 human beings are to-day using Spanish in various parts of the world.

Castilian, the standard form of Spanish, attained to the dignity of a literary medium by the 12th century, about or soon after the middle of which there appeared the noble epic poem, ‘El Cantar de Mio Cid,’ and the little liturgical play, ‘El Misterio (or Auto) de los Reyes Magos.’ But in legal, ecclesiastical and other documents we can trace its evolution, during some five or six centuries prior to that time, from the popular Latin of the more or less illiterate soldiery and colonists brought to the peninsula as a result of the Roman conquest. By the time of Augustus the conquest had become an achieved fact, and during the four centuries of peace that followed his reign the Romanization of the land, so thoroughgoing for its institutions and customs, was a practically complete process for its speech also. It is dubious that, apart from a very scant number of debatable elements of the lexicon, any vestiges of the idioms of the original Celtic and

Iberian tribes remain in the Castilian language. Vulgar (popular) Latin is the all-important source of its lexicon, phonology, morphology and syntax. In the course of time its vocabulary has been enriched by accretions from Arabic — brought in by Moorish conquest from 711 on — from other European languages, especially French and Italian, and from the Indian and other native languages of the colonial settlements.

Phonology.— With the invasion of the Germanic barbarians and the fall of Rome, in the early 5th century, political contact with Italy was severed, and the Vulgar Latin of Hispania began to undergo the changes in sound that produced ultimately Castilian in the high plateau of the centre of the peninsula.

In the following statement of facts we are concerned only with popular developments: words of peculiarly learned use did not necessarily go through the popular phonological processes.

In the vowel system it is notable that, under the accent, Latin *a* (long and short), *ē, ī, ō, ū*, were represented in the Vulgar Latin enunciation by close variations of the same sounds, i.e, qualitative distinctions, as between open and close utterance, became important for them as for all vowels. Latin *ĭ* became Vulgar Latin close *e* also, and Latin *ŭ* became close *o*. With their close pronunciations these vowels remained in Castilian unless affected by some adjoining sound (notable a palatal): Latin *mātrem* (the oblique case and not the nominative is the basis of the Spanish word), «mother»; *pătrem*, «father»; *plēnum*, «full»; *bĭbit*, «drinks»; *fīlium*, «son»; *formōsum*, «beautiful»; *lŭtum*, «mud»; Cast., *madre, padre, lleno, bebe, hijo, hermoso, lodo*.

Accented Latin *ĕ* and *ŏ* diphthongized to *ie* and *ue*, in both open and closed syllables: Latin, *vĕnit*, «comes»; *fĕrrum*, «iron»; *mŏvet*, «moves»; *fŏrtem*, «strong»; Cast., *viene, hierro, mueve, fuerte*. This is one of the distinctive features of Castilian as compared with the other leading Romance languages, French, Italian and Portuguese; for in these latter the diphthongization occurred not at all (as in Portuguese) or only in open syllables (as in French and Spanish); cf. Cast., *fuerte*, «strong,» with Ptg. *forte*, French *fort*, Italian *forte*, and Spanish *viento*, «wind» from Latin *vĕntum* with Ptg., *vento*, French *vent*, Italian *vento*. A following or preceding palatal might prevent the diphthongization of the *ĕ* and *ŏ* or work further changes in a diphthong already produced from them. The Latin diphthong *æ* was treated like Latin *ĕ*, *cælum*, «heaven,» Cast., *cielo*, *au* like Latin *ō*, *aurum*, «gold,» Cast., *oro;* the few cases of Latin *oe* present some difficulty. Latin *foedum*, «ugly,» Cast., *feo*, Latin *foenum*, «hay,» Cast., *hieno*.

In the initial position in the word the vowels and diphthongs of Latin leveled away distinctions of quantity and quality and became simple *a, e, i, o, u*, which, in some cases underwent modification through adjacent vocalic or consonantal influences. In the final unaccented position the vowels simplified still further to Castilian *a, e, o*, in truly popular treatment. In the unaccented penult of words stressed on the antepenult the vowel *e* (Latin *ĭ*) usually disappeared; in the final unaccented syllable it could also disappear after consonant sounds which the genius of the language permits to end a word.

The consonants of Latin have proved more persistent in the initial position in the word than elsewhere; but a characteristic of Castilian is the change of *f* before a vowel (but not before the Castilian diphthong *ue*) to Old Spanish aspirate *h* (still written *f* in the older stages of the language). In modern Castilian the written *h* is silent, except for a possible slight aspiration before *ue*: cf. Latin *filium*, Old Spanish *fijo*, modern *hijo*, with *fuerte*. Initial consonant plus *l* has yielded palatal *ll*: Latin *clamare*, «to call,» *flamma*, «flame,» *plorare*, «to weep,» Castilian *llamar, llama, llorar*. Initial *r* has become a well-trilled sound, and this same sound is rendered by *rr* between vowels. Another characteristic of Castilian is the conversion of both Latin *b* and Latin *v* (*u* in hiatus) to a single bi-labial spirant sound written either *b* or *v*: the sound of English *v* does not exist in Castilian. Latin *c* before *e* or *i* assibilated in Old Spanish to *ç* or *z*, which now, whether written *c* or *z*, mean the interdental sound of English *th* in «thin.» In the intervocalic position a Latin single voiceless consonant is voiced: e.g., *t* became *d*, *p* became *b*, *c* became *g* (before any vowel but *e* or *i*); but intervocalic *s* is always voiceless in modern Spanish. Consonantal combinations between vowels were subject to a variety of changes not easily epitomized, but simplification was the usual process. The doubling of the same consonant is not a feature of modern Spanish; it is found only in the cases of *cc* and *nn* and both of the *c*'s and the *n*'s must be uttered, as in *facción*, «faction» and *innoble*, «ignoble»; *rr* denotes a reinforced *r* sound, while *ll* denotes a palatized sound and is not a doubled *l* in value; *ñ* (*n* with a *tilde*) means a palatalized *n* (approximately the *ny* of «canyon» from Castilian *cañón*). Of the consonants actually final in Latin the commonest were *s* and *t*; of these *t* was lost, Latin *amat*, «loves,» Castilian *ama*, while *s* has remained and is very useful as a flexional sign (it marks the plural of substantives and the second person of verbs, Latin pl. *partes*, «parts,» Castilian *partes;* Latin *amas*, «thou lovest,» Castilian *amas*).

Accent.— The stress in the Castilian word may fall on the final syllable, the penult or the antepenult; occasionally it may fall upon a syllable more than three places removed from the end of the word. All words not stressed on the final or the penult must have a written accent. Words ending in a consonant except *n* or *s* normally stress the last syllable and need no written accent; those so stressed and terminating in *n* or *s* must have the written accent. Words ending in a vowel or diphthong and stressing the penult need no written accent; but all words stressing a final vowel or diphthong require the written accent thereon.

Morphology.— For substantives a great simplification has occurred in the passage from Latin to Castilian, in that the six cases of the noun and adjective have been reduced to one in Castilian, and this usually corresponds to the Latin accusative singular and plural. Latin genitive, dative and ablative relations are rendered by combinations of prepositions with the single Castilian form; *del hombre,* «of the man,» Latin, *hominis,* etc. In the personal pronouns there are still certain case distinctions: *yo,* «I,» *me,* «me,» *a mí,* «to me,» etc. There are no neuter nouns in Castilian; the Latin neuters become masculines for the most part, but a few become feminine.

The verb system also shows a reduction of the complex system of Latin inflections, but it still possesses many and varied conjugational forms. The Latin passive voice disappeared; its place has been taken by periphrases with the passive participle or by a reflexive or other construction. The Latin future indicative tense did not survive; it was replaced by a new form made by adding the present tense of Castilian *haber,* «to have,» to the infinitive of the main verb: *amar,* «to love,» plus *he,* «I have,» *amaré,* «I shall love.» Suffixes derived from the imperfect indicative of *haber* are used similarly to form a past future (or conditional) on the infinitive of the main verb as a base. Castilian perfect tenses are formed by combining tenses of *haber,* «to have,» with the past participle of the main verb; *he amado,* «I have loved.» The Latin imperfect subjunctive was lost, but Castilian has two such tenses (ending in *-se* and *-ra* in the first singular), of which the one comes from the Latin pluperfect subjunctive and the other from the Latin pluperfect indicative. There is a future subjunctive, derived from the Latin future perfect indicative and perfect subjunctive; its use has become greatly limited in recent times. Conventionally we speak of three regular conjugations in Castilian, denoted usually by their infinitive endings, *-ar, -er, -ir;* in point of fact the endings of the *-er* and *-ir* conjugations are the same for all except four of their many forms, so that the Latin four conjugations have virtually been cut down to two. A number of verbs are perfectly regular as to their endings but show certain variations in their root vowels; they form what are known as the radical-changing classes. There are no few irregular verbs.

Syntax.— There are interesting phenomena that might be considered here, but the present purpose may be served by calling attention to one of the most decided peculiarities of the Spanish language, its use of the preposition *a,* «to, at,» before a noun denoting a specific person, higher animal or personified thing and standing in the accusative relation to a verb: «I see the man» is *veo al hombre* (literally, «I see to the man»). The order of words in a Spanish clause is a very elastic matter. In general the English declarative order of subject, verb, object, is but little adhered to; in a simple statement of fact the verb or the object may begin the clause, so that inversion is frequent in the language.

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SPANISH LAW. The system of jurisprudence and judicial practice as developed in Spain and later extended to the Spanish West Indies, Central America, Mexico, the Spanish-speaking countries of South America and the Philippines. It is one of the oldest systems of law, and as at present constituted is a mixture of Roman, Germanic and Arabic elements, with marked traces of the influence of canon law.

Roman law became dominant in Spain as early as 200 B.C. and retained its supremacy practically until the conquest of the Visigoths, after which the Germanic law coexisted with the Roman law. There were several codifications of the law before the year 653. The Arab conquest of the 8th century was an important factor in modifying Spanish law. About 1265 Roman and canon law became prominent. Then succeeded several centuries of struggle for supremacy between the native and the Roman law. The various codes existing at this time caused great confusion in the positive law, and unsuccessful attempts were made to simplify it during the reign of Ferdinand and Isabella (1490–1502). Later the Justinian and canon laws spread rapidly throughout many of the kingdoms of the peninsula. In 1567 a general code was promulgated. A peculiarity of Spanish legislation is that no code has ever been promulgated to repeal the old codes, and the result has been difficulty in interpreting the existent law.

At the adoption of the constitution of 1876, which is now in force, civil, commercial, criminal and military law have been incorporated into separate codes. Likewise a judiciary act and codes of civil and criminal procedure have been adopted. In 1910 a commission was appointed to revise and recodify the procedural, penal and civil codes and the judiciary laws.

The Spanish civil code was promulgated by decree in 1889, and extended to the colonies later in the same year. It is still in force. This code, which is divided into four books, deals with corporations, the law of persons, marriage, guardianship, law of property, contracts, jurisdiction, conflict of laws, etc. The subject of marriage was formerly left to the canon or ecclesiastical law, but under book one of the code of 1889 civil marriages are permissible, with the important qualification that all persons who profess Catholicism must celebrate the canonical form. The third book of this code provides that no private property shall be taken for public use without due compensation — an exact counterpart of the principle made familiar in the United States by constitutional provisions. A noticeable feature of the Spanish law in regard to the descent of property and succession makes it illegal for a parent to disinherit legitimate children. Two-thirds of the estate is thus reserved. Some criticism has been aimed at the code of 1889, among others that it is incomplete. As instances it is said to contain nothing regarding certain prior laws such as those relating to mines, hunting, fisheries and civil registry. In addition it leaves questionable the relation of non-Castilian legislations and the customary law to the civil code. With the exception of the subject of marriage this code has only subsidiary force in the provinces of Aragon, Catalonia, Navarre and the Balearic Isles. The Roman law, civil and canon, is still subsidiary law in Catalonia.

The commercial code, owing to imperative need, antedated the civil code. Spain is said to have produced the first code of mercantile law in the "Ordinances of Bilboa" (1737), which spread to America and remained in effect in Mexico until 1884. Spain codified commercial law in 1830. The great commercial development of the country late in the 19th century emphasized the need of reform, and in 1885 a new code went into effect, which later in the same year was extended to Cuba and Porto Rico. Much supplementary legislation has been enacted in late years. The commercial code treats of commerce and registry, commercial contracts, banking, railroads, insurance, mercantile guaranties, commercial paper, maritime commerce, shipping, insolvency, bankruptcy, limitation of actions in commercial affairs, etc.

Civil procedure is governed by the act or code of 1881, as amended, and the judiciary act of 1870, as amended in 1882. The code of 1881 in amended form was extended to Porto Rico in 1885 and to the Philippines in 1888. Procedure in commercial cases is governed by the code of civil procedure since commercial courts were abolished in 1868. The code of civil procedure, which is arranged in three books, contains some provisions in conflict with the civil code, which was enacted subsequently. Spanish civil procedure is divided into two classes according to the nature of the action, contentious (*contenciosa*) and voluntary or non-contentious (*voluntaria*). Voluntary jurisdiction is used when there is no contention between the parties, but judicial proceedings are necessary to fix legal rights, as in cases of guardianship, administration, adoption and the like. This resembles the non-contentious jurisdiction of France, Germany and other countries of Europe. A rather remarkable feature of the code is that it provides for arbitration of civil actions out of court. Special provisions are also made in this code for procedure in voluntary jurisdiction in commercial cases.

Notarial law is of more importance than in Great Britain or the United States. Under Spanish law nearly all deeds, contracts and important agreements must be certified by a notary.

Military and naval courts of Spain have ampler powers than in the United States. The military law is governed by the code of military justice promulgated in 1890. Naval jurisdiction is considered as belonging to the military establishment, but is largely governed by the penal code of admiralty of 1888. There are no separate admiralty courts in Spain for civil cases, the ordinary tribunals having jurisdiction of such suits.

The ancient Spanish codes treated the subject of criminal law quite completely. Formerly the laws were unusually harsh, but during the 19th century, in keeping with the spirit of the times, many reforms were introduced, some as early as 1812. The present code, authorized by the act of June 1870, made only a few material changes from the code of 1848. Modifications of the present code were made in 1876, 1904 and 1908. An amendment of this code was extended to Cuba and Porto Rico in 1879 and to the Philippines in 1886. The Spanish criminal law classifies offenses according to their nature into felonies, crimes and misdemeanors. Punishments are classified as afflictive, correctional, light and accessory. The first class commences with death and includes numerous forms of imprisonment down to disqualifications. The second class includes imprisonment and arrest, public censure and suspension from the privilege of holding certain offices or pursuing certain callings. The lighter forms of punishment include arrest and private censure. In any of these three classes offenders may also be fined or put under recognizance. The accessory punishments include payment of costs, civil interdiction and degradation. Until modern times the system of criminal procedure under the codes was the secret and written procedure, the hampered defense and torture. This system was reformed by the code or act of 1882, which substituted the accusatory system. This code to date has had few amendments. It was extended after amendment to the Philippines, Cuba and Porto Rico, where it became effective in 1889. Among the most important changes in procedure in Spain in recent years was the re-establishment of the jury in criminal trials in cases of felonies and some misdemeanors (1888), but it has not been extended to Cuba, Porto Rico or the Philippines; nor is it employed in many of the Mexican states or in the remaining Spanish-American countries. Every trial involving the more serious offenses is commenced by a *summario,* which resembles the secret investigation of a grand jury, after which the accused is kept in solitary confinement while an *ex parte* investigation is made by a judge of the first instance and the state's attorney (*fiscal*). Proceedings based on the constitutional provision prohibiting the detention of accused persons except for just cause somewhat resemble *habeas corpus* proceedings of the United States and Great Britain.

The judiciary act, comprising 932 articles, supplemented by special statutes, makes provision for the various courts. There are three grades of civil courts: Courts of the first instance, courts of appeal and the Supreme Court, which sits at Madrid. Jury trial is not employed in civil cases.

Spanish law differs radically from that of Great Britain and the United States in having no judicial legislation (so-called "judge-made law"), the decisions of none of its courts having binding power as precedents.

The official legislation of modern Spain commenced, it may be said, with the convening of the Cortes in 1810, and two years later the first constitution was promulgated. Previous legislation consisted of edicts of the kings with codes of law authorized by royal decree. The Supreme Court was authorized by the constitution of 1812, but it was not finally organized until 1834. An important reform in the criminal law was made by the act of 1908, relating to conditional sentence, by which, under certain circumstances, sentences may be suspended. Capital punishment still exists, although many efforts have been made to abolish it. Another feature of modern legislation provides in case of wrongful convictions, under certain circumstances, that the judges are held civilly liable. In late years Spain has enacted many laws providing for social and economic reform. Among them may be mentioned a workmen's compensation act (1900); industrial courts to adjust differences between employers and employees (1908); a national institute for old-age pensions (1908); regulation of employment of women and children (1900–08); recognizing the right of employers to organize and of employees to organize and strike, and fixing penalties for inciting employees to strike. Other legislation of a similar nature is still (1918) pending.

Edward F. Donovan.

SPANISH LITERATURE. For the sake of convenience the history of Spanish literature as written in the motherland may be regarded as constituting four chronological divisions, namely, the Old Spanish period, extending from the 12th century down to the 16th; the Golden Age, which runs through the 16th and 17th centuries; the period of the 18th century; and the more recent period, which reaches from the beginning of the 19th century to the present moment.

Old Spanish Period.— Heroic tradition informs the most noble composition that the Middle Ages have bequeathed to Spain, the 'Poema del Cid' (or 'Cantar de Mio Cid'). This seems to have taken form by the middle of the 12th century or not long after that date, and as is unfortunately the case with still other notable works of the Old Spanish period, it is preserved to us in but a single manuscript, which is in a badly garbled condition. Belonging to the 14th century and being, therefore, about a century and a half later than the original composition, this manuscript must not be deemed a faithful transcript of the poet's labors; in all probability it reflects many of the linguistic and other features of the scribe's own time. As it stands, the document has some 3,700 odd lines. These are usually bound together into stanzas or *laisses* (to use a term employed to designate a similar arrangement in Old French epic poetry) of irregular length, with vocalic rhyme or assonance as the binding principle. In the manuscript the lines vary greatly as to the number of syllables that they contain; some lines are very long, others are very short. As a result there are scholars who consider the poem as having been ametrical in the inception. It is possible, however, to argue that the original document was perfectly metrical and to say that its present metrical irregularity is due to imperfect redaction and to scribal bungling. On the basis of facts derived from internal criticism and in consonance with a feeling that the true Old Spanish heroic measure was the same that is still seen in the *romances* or ballads (the oldest of which are heroic in nature), it is not unwarrantable to declare that the author of the 'Poema del Cid' used long verses of 14 to 16 syllables each, and that the individual verses broke regularly into half-lines with a verse stress on the seventh syllable in each half-line. Mingling fact and fiction, the 'Poema' is a fine epic dealing with the career of a great Castilian hero, who lived in the 11th century, Rodrigo or Ruy Díaz de Bivar, who received the title «Cid,» «Lord,» from the Moors. We see him passing into exile at the behest of his monarch, Alphonso VI of Castile and Leon, engaging in battle with both Moor and Christian, and assuming control of Valencia, after he has taken it from the Moor. The element of fiction seems to be the prevailing one in another document, the 'Crónica rimada del Cid,' apparently of the 14th century. This (termed also the 'Rodrigo') is deemed by some a chronicle in verse, while others do not hesitate to call it an epic or at least an aggregation of epic ballads. Its narrative relates especially to the early life of the hero; its form exhibits a disturbance of verse conditions no less serious than in the case of the 'Poema del Cid.' A still older hero, the valorous Castilian Count Fernán González of the 10th century, is celebrated in a school epic (back of which there was probably a more popular composition) of the 13th century. It is in monorhymed quatrains of alexandrines,— a form of verse which now gained favor for narrative purposes and maintained itself in vogue for some time — and it is not preserved in its entirety.

Such are the documents regularly cited as examples of Old Spanish epic composition; no others appear to have survived. But Old Spanish heroic tradition was certainly more extensive and treated of still other warriors and their deeds. Whether this was done in poems of some length or only in brief epico-lyric compositions or ballads is a matter under discussion, but at all events we know that during the Middle Ages the *juglares* or minstrels of Spain entertained both nobles and commoners with their versified accounts of the exploits of various heroes besides those already mentioned. These versified accounts have passed from view, but the substance of them — with occasional retention of verses of the originals — are found in prosified form in the 'Crónica General,' which was begun at the incentive of King Alphonsus X of Castile in the 13th century, so that this great chronicle is aptly styled a treasure house of Old Spanish heroic tradition. On the basis, then, of material preserved in the 'Crónica General' we may assume that older Spain possessed heroic song about the Seven Infantes de Lara; about an Asturian hero, one Bernardo del Carpio; about certain descendants of Count Fernán González; about Roderick the Goth, whose criminal love is said to have brought on the invasion of Spain by the Moors; and about Charlemagne, who is alleged to have been a youthful exile in Saracen Spain. It may be stated here that from the 15th century on all the heroic figures enumerated play a part in the rich balladry of Spain that is actually preserved.

The oldest known drama in Spanish probably came into existence at about the same time as the 'Poema del Cid.' It is a brief mystery play in rather elaborate verse form on the visit of the Magi to Bethlehem, and it seems to derive from a Latin original written in France. But from the 12th century down to the middle of the 15th no other Spanish play has survived; there is, however, unmistakable evidence that pieces both religious and profane in nature were performed during the interval.

The first Spanish poet known to us by name, Gonzalo de Berceo, made his appearance in the first half of the 13th century. Berceo showed his genuine religious devotion by composing in unpretentious verse (quatrains of monorhymed alexandrines, called *cuaderna via*) lengthy lives of saints (Saint Dominick of Silos, Saint Æmilianus, etc.), charming miracles of the Virgin ('Milagros de Nuestra Señora), and kindred works. There is some reason to ascribe to him a voluminous account in *cuaderna via* of the deeds of Alexander the Great ('Libro de Alexandre'), which is otherwise anonymous. Anonymous as yet is a poem ('Libro de Apolonio') on the adventurous career of Apollonius of Tyre. Verse documents of less importance and also of the 13th century include a narrative dealing with the Legend of the Good Thief (but improperly called in the manuscripts the 'Book of the Three Kings of the East'), a Life of Saint Mary of Egypt ('Vida de Santa María Egipciaqua'), a Debate between Body and Soul, and a Debate between Water and Wine, with which is combined the oldest love song in the language. An adherence to Gallic sources and models is certain for some if not all of these documents.

It was chiefly through the efforts of Alphonsus X (reigned 1252–84) that Spanish prose composition received its first development. This learned sovereign made his court a centre for scientific and literary activity, and with the coöperation of the scholars whom he gathered about him he produced important astronomical, legal and historical compilations. It is a noteworthy fact that the king himself gave particular attention to the style of the documents thus compiled. Chief among them are the astronomical tables known since as the Alphonsine Tables; a comprehensive legal digest accompanied by a philosophical and interpretative commentary, the famous 'Siete Partidas'; and the 'Crónica General' (or 'Crónica de España') cited above. Following the fashion of the day he wrote his lyric verse in the language of Galicia, a form of Portuguese. After the close of the reign of Alphonsus and before the end of the century appeared the 'Gran Conquista de Ultramar,' which derives in part from William of Tyre's Latin history of Godfrey of Bouillon's crusade and in part from French and Provençal material of a romantic and novelesque nature. Very soon original prose fiction in Spanish became an actuality with the work entitled the 'Caballero Cifar,' and in the first half of the 14th century the short story was consciously and carefully elaborated in the framework of tales due to a prince of the royal blood, Juan Manuel (1282–1348), a nephew of Alphonsus X. Inspired by the labors of his uncle, whom he admired greatly, the warrior and statesman Juan Manuel found time not only for the composition of the 50 tales in his 'Conde Lucanor,' but also for that of much didactic material. Not the least interesting among prose writings of the 13th and 14th centuries are certain Spanish versions of sententious material taken from Arabic; from them seems to date the later widespread use of the proverb by the Spaniard.

The first genuine poet — the verse hitherto produced is not of a transcendent quality — comes to view in the person of the wayward cleric, Juan Ruiz, archpriest of Hita, in the first half of the 14th century. Even in the prison to which he was properly condemned for his misdeeds he continued to write lyrics of a spontaneous and self-revelatory sort. He collected them into what he termed capriciously his 'Book of Good Love' ('Libro de Buen Amor'). While he narrates some of his own scabrous love affairs, he also displays his knowledge of Ovidian material and some acquaintance with French works, and he imitates a form of the popular lyric in his mountain-girl songs. The leading work in verse in the latter half of the 14th century is the 'Rimado de Palacio' of Pedro López de Ayala, a versatile man, who became Grand Chancellor of Castile. He served under four kings, and reveals his knowledge of affairs in his prose chronicle of their reigns, a work which is one of links in the series of chronicles stretching from 'Crónica General' of Alphonsus X down to the appearance of fully elaborated historical works in the age of the Renaissance. The 'Rimado de Palacio' is largely satirical in its constitution, inveighing against the vices and defects in all forms of society of his time.

During the long reign of Juan II of Castile, which nearly coincides with the first half of the 15th century, the court was thronged with versifiers whose methods were principally an imitation of those of the Provençal troubadours. These had been welcome visitors in Spain for a couple of centuries before and their themes had been acceptable to high society, especially their theorizing on love. But the re-echoes of their speculation that we find in the ditties of the Spanish poetasters of the 15th century are in the main stale and unprofitable, as may be seen in a survey of the examples contained in the collection ('Cancionero de Baena') made by the court physician and versifier, Juan Baena. In Aragon the Provençalizing methods also had vogue and they passed over to Italy with the establishment of an Aragonese court at Naples; some of the Spanish compositions written in Italy are assembled in the so-called 'Cancionero de Stúñiga.' At the Castilian court an allegorizing tendency, harking back above all to Dante and Boccaccio, was very marked, and the first notes of the coming Renaissance were struck when versions were made of some of the works of classic Latin. Enrique de Villena, an eastern Spaniard, related to the royal houses of both Aragon and Castile, was in no few respects an early Spanish humanist. The Castilian Íñigo López de Mendoza, Marqués de Santillana, was one of the more truly inspired writers of the time; he shows some appreciation of the popular poetry of his own land, along with an impress of Italian influences; and he used the allegorical forms with somewhat more felicity than most of his contemporaries. The most elaborate employment of allegorical machinery was made by Juan de Mena, court historiographer of Juan II, as may be perceived in his poem 'El Laberinto,' which also evidences the Spaniard's interest in the humanistic movement now spreading out from Italy.

While with austerity the inevitableness of death is preached in the stanzas of the Castilian 'Dance of Death' ('Danza de la Muerte'), a different view of the perishability of all things mortal is taken by the true poet Jorge Manrique (1440–78) in his sweet and mournful 'Coplas,' in which he declares that this mortal existence is but the threshold leading to the real life beyond the grave; gentle resignation is his key-note. From the pen of Gómez Manrique, the uncle of Jorge, now comes the first plays in Spanish known to have been committed to writing since the appearance of the 12th century mystery play, and they are rather elementary in their make-up. Prose is used for satirical purposes with no little harsh effect by Martínez de Toledo, archpriest of Talavera, in his violent attack on woman, the 'Corbacho.' For historical purposes it is employed worthily by Fernán Pérez de Guzmán, whose character portraits in his 'Generaciones y Semblanzas' merit a place of distinction.

The Spanish ballad is one of the most prized manifestations of the national literary spirit. Naturally the earliest of those preserved in print could not precede the setting-up of the press, which appears to have occurred about 1474; only very few have been handed down from antiquity in manuscript form and none of these can antedate the 15th century. The oldest extant among the more than 2,000 ballads are heroic in subject, acclaiming the national heroes whom we have seen figuring in the Old Spanish epics and in accounts embalmed in the 'Crónica General.' According to an ingenious theory advocated by some leading Spanish scholars the most ancient among the ballads were simply portions of still older epics about the heroes, the parts of these latter that the people demanded most insistently from the popular entertainers, the *juglares,* who chanted and recited them; and the later ballads were modeled on these brief extracts. It has not been demonstrated, however, that ballads, that is, brief epico-lyric narratives, did not exist even as early as the very time of the heroic personages whom those known to us commemorate; such may have been the fact and they may have been kept alive by oral tradition until finally the first broadsheets were turned off from the press in the 15th century. At all events the Spanish ballad lives on with undiminished vitality; from the 16th century trained writers have imitated their form, and wherever people of the Spanish stock are found to-day new ballads are being produced by them. Certainly one of the most important works issued from the press before the end of the 15th century was the first discoverable edition of the famous chivalric romance, 'Amadís de Gaula,' the parent of a numerous progeny of Amadises, Palmerines and other stories of derring-do that were to keep on appearing down to the beginning of the 17th century, when the 'Don Quijote' was to give them their quietus. In some form or other the 'Amadis de Gaula' was already in circulation back in the 14th century, for there are references to it in other works of that period. Another noted novel, one actuated by a spirit which we now call naturalistic, was printed at least as early as the opening of the 16th century. This was the 'Celestina' or 'Tragicomedia de Calisto y Melibea,' which is strictly speaking an example of prose fiction in dramatic form.

Golden Age.— Under Charles V Spain attained to the proportions of a world empire, and a glorious development in literature as well as the other arts attended her great growth in political importance. During the preceding reign of Ferdinand and Isabella there were already clear signs of the inauguration of that period of literary splendor, which the Spaniards term their *siglo de oro,* for a large measure of the humanistic culture of Italy had been transmitted to the Iberian Peninsula in the time of the Catholic sovereigns. In poetry a direct influence of Italian literature manifested itself ere the 16th century had proceeded far in its course, for through the efforts particularly of Juan Boscán (d. 1542) and Garcilaso de la Vega (1503–36) the various forms utilized by the Italians were imported into Spanish, and the old prosody was enriched by the addition of the 11 syllabled line, the octave, the sonnet, the ode, etc. The labors of these two poets in Spain paralleled in permanent effect those of the Pléiade in France and of Wyat and Surrey in England. Other writers such as Diego Hurtado de Mendoza, Acuña and Cetina helped to acclimate the new forms and prevailed over more conservative spirits like Castillejo who resisted the innovations.

The flourish of the drama was perhaps the most distinctive feature of the century and a half or more during which the Golden Age of Spanish letters was in full vigor. The patriarch of the Spanish theatre was Juan del Encina, who had already begun to write before the end of the 15th century and who, like numerous Spanish authors after him, spent some time in Italy. Service in the Spanish campaigns took these men to the land of the Renaissance, where they imbibed the spirit prevailing there. A nomadic soul, Torres Naharro, published at the Aragonese court of Naples, in 1517, a collection of plays in which prominence is given already to the punctilio (*pundonor*), a motive which was to be stressed to an extraordinary degree in the further development of the Spanish drama. Lope de Rueda (d. c. 1565) imitated Italian dramatists very directly in his longer pieces, but attained his real success in the composition of brief comic interludes (*pasos*) that brought upon the scene popular characters taken from the life of the time. Rueda was an actor and stage-manager as well as a writer; since his time the vogue of the short one-act play of humorous and occasionally farcical tendencies has never died out in Spain; it is the *género chico* of to-day. With the pieces of Juan de la Cueva (d. c. 1609) the historical drama was introduced and to a certain degree he anticipated also the *comedia de capa y espada* which Lope de Vega was to cultivate with wonderful skill. Cervantes (1547–1616) essayed with no meed of success the rôle of the playwright, although two of his longer plays, the 'Numancia' and the 'Trato de Argel,' are not negligible. But beyond all odds the dominating personality among all Spanish dramatists of the first half of the Golden Age was Lope de Vega (1562–1635), who, inheriting technical details of dramatic composition from his immediate predecessors, applied them with the unerring skill of a dramatic genius. After Lope and until the end of the Golden Age the pre-eminent playwright was Calderón (1600–81). Lope tried his hand at practically every possible form of the drama and reached the height of his fame with his elaboration of the comedy of character and manners (*comedia de capa y espada*); his fertility was prodigious, as he seems to have written no fewer than 1,500 pieces. Calderón was not so markedly successful with the play of manners, but he charmed his contemporaries as he still pleases posterity with the lyricism that pervades his pieces. He is celebrated most of all for his perfecting of the allegorical and religious drama dealing especially with the virtues of the Eucharist (*auto sacramental*). Lope, it should not be forgotten, exercised his talents in many directions and left untried hardly any of the genres; he will always be classed among the best of Spanish lyric poets. Other dramatists of the *siglo de oro* of pronounced merit were Gabriel Téllez (pseudonym, Tirso de Molina; 1571–1648), Guillén de Castro (1569–1631), Ruiz de Alarcón (d. 1639), Rojas Zorrilla (d. 1660) and Moreto (1618–69).

The dramas of the Golden Age are regularly in verse. In prose the most distinguished achievements took form in the novel and the short story, and a consideration of these at once suggests the name of Cervantes (1547–1616). His 'Don Quijote' (First Part, 1605; Second Part, 1615), the most noted work of Spanish *belles-lettres* and the greatest novel in the history of the world's literature, was begun as a satire upon the methods of the novel of chivalry but remains important as one of the most eminent expositions of the never-ceasing struggle between realistic and idealistic impulses in human nature. His 'Exemplary Tales' ('Novelas Ejemplares') set up a model for the shorter form of prose fiction. Before the middle of the 16th century there had been printed the 'Lazarillo de Tormes,' the earliest of the picaroon stories or novels of roguery, which, if not the work of Hurtado de Mendoza, must remain anonymous. Later novels of the type, recounting the wanderings and exploits of a roguish hero, are the 'Guzmán de Alfarache' of Mato Alemán (d. 1609), the 'Pícara Justina' (1605), of Úbeda, the 'Buscón' of the publicist and satirist Quevedo, and the 'Marcos de Obregón' of Vicente Espinel (1618). After Cervantes the short story was cultivated with some understanding by Salas Barbadillo, Castillo Solórzano and María de Zayas. The pastoral romance was attempted by many writers, even Cervantes and Lope de Vega being of the number, but the highest measure of success in the genre was achieved by Jorge de Montemayor in his 'Diana' (c. 1558), and by Gil Polo in his sequel thereto. A solitary but not infelicitous example of the historical novel in the age is the 'Guerras Civiles de Granada' of Pérez de Hita. True history writing takes the place of the earlier chronicles at this time, above all in the 'Historia de España' (written originally in Latin) of the Jesuit Mariana (d. 1623), in the accounts of affairs in eastern Spain by Zurita, and in the records of happenings in the New World by Antonio de Solís (d. 1688), and many others. History was intentionally mingled with fiction by Antonio de Guevara (d. 1545) in his 'Marco Aurelio' and his 'Década de los Césares,' and to him is due also the 'Epístolas Familiares,' a work which in translation eventually reached England and is said to have helped to promote an over-refined style of composition there. At least a mention should be made of the prose labors of the religious of the period who wrote many documents of a mystical, devotional and purely theological sort. Prominent among the mystics were Saint Theresa (1515–82), Saint John of the Cross (d. 1591), Luis de Granada (d. 1588) and Luis de León (1527–91). The last named is one of the most attractive of all Spanish lyric poets, and shows his mystical bent in his verse no less than in his prose. Other lyric poets of high rank are Herrera (1534–97) and Rioja (d. 1659). The epic was essayed after the fashion of the Italians Ariosto and Tasso by many authors, including Lope de Vega and Barahona de Soto, but the only truly meritorious performance of the kind is the 'Araucana' of Alonso de Ercilla (1533–94), dealing with campaigns against the Indians in South America in which he played a part.

Even at the moment of greatest efflorescence the seeds of ultimate decay were sown in Spanish literature, and chiefly by the poet Luis de Góngora (1561–1627), who deliberately engaged in the use of stylistic excesses of many sorts, such as intentional obscurity of expression, and the like. He was unfortunately taken as a desirable model by even the most famous writers and hence the spread of the manner called Gongorism (also culteranism or cultism), which, as the 17th century wore on, it was deemed absolutely necessary for writers to employ in both prose and verse. While Gongorism played with the external form of literature, gradually debasing it, there were other mannerists who purposely juggled with the philosophic idea of concept, and thus added a sinister influence. The methods of the Conceptists may be judged by the works, which are nevertheless of substantial merit in certain regards, of the Jesuit Gracián (1601–58).

The 18th Century.—After the death of Calderón (1681) it may be said that a period of decay set in rapidly in the field of letters; it became well-nigh absolute in the early years of the 18th century. The writers were still many but their æsthetic sense and that of their readers were of a deplorably low order. The advent of the Bourbons with Phillip V, who came to the throne in 1700, led to a large influx of Frenchmen to the court and a considerable Frenchifying of fashions. From France there came also the neo-classic methods of her writers, which the critic Ignacio de Luzán (1702–54) recommended to his Spanish fellow-countrymen as providing a panacea for the literary ills of Spain. In his 'Poética' (1737) Luzán paid particular attention to the reform of the Spanish theatre which had fallen into a chaotic condition and he urged the adoption by Spanish playwrights of the three unities and the other leading principles of neo-classic restraint which had been in force in France since the 17th century. The ideas of Luzán met with acceptance; there was some translation of French dramatic pieces and some Spaniards of talent wrote original plays cast in the French classic mold. Among these were N. F. de Moratín (Moratín the Elder, 1737–80), the statesman Jovellanos (d. 1811), and Moratín, the son (Leandro Fernández de Moratín, 1760–1828). The greatest of the trio was the last named, who acquired favor with the many by means of his pieces reflecting his veneration for the French dramatist Molière; and especially by his two prose plays, 'El Café' and 'El Si de las Niñas.' A school of poets who gathered about Meléndez Valdés, a professor at the University of Salamanca, sought to subordinate lyric composition to the same principles of neo-classic restraint and, though they succeeded in attaining to some plasticity of form, they did so to the detriment of emotional expression. In the domain of the versified fable a high degree of excellence was reached by Iriarte (1759–91) and Samaniego (1745–81), who were familiar with the work of La Fontaine and of other foreign fabulists as well. With a satirical novel, the 'Fray Gerundio' (1758), the Jesuit Isla gained much éclat and also contrived to bring about a reform of the sensational methods of preachers of his day. Isla won notice, furthermore, by his Spanish translation of the 'Gil Blas' of the French novelist Lesage, which, in accordance with a false assertion of Voltaire, he regarded as a plagiarism of a lost Spanish picaroon romance. The scientific discoveries of the outside world were communicated to his countrymen by the Benedictine Feijoo (1726–1829) through the medium of the essays contained in his 'Teatro crítico' and his 'Cartas eruditas y curiosas.' The cultured soldier José de Cadalso (1741–82) repeated in his 'Cartas Marruecas' the satirical methods utilized by Montesquieu, in his 'Lettres persanes,' and derived inspiration for his 'Noches lúgubres' from Young's 'Night Thoughts.' Ramón de la Cruz (1731–94) showed the universal predilection for things Gallic in his adaptations of French plays, but he took a unique stand for the age when he produced his *sainetes* of an entirely native flavor, for they are one-act pieces reproducing the methods of the old *paso*. Sarmineto, Hervás and Arteaga are notable among the historians, scholars and critics of the period.

The More Recent Period.— Only to a slight degree did the rationalistic spirit of the French 18th century show itself in the workings of the minds of the French writers who have been mentioned thus far as subordinating themselves to the precepts of neo-classicism. But in the leading author of the opening of the 19th century rationalism dominates along with fiery liberalism. He is Quintana (1772–1857). His enduring fame, however, rests more upon the heroic odes in which he, a patriotic Spaniard, assailed the Napoleonic invaders of his land during the War of Independence. With him was associated the priest Gallego (1777–1853), who wrote patriotic odes and elegies of highly plastic form. Though they fought the Frenchman as the enemy of their country, Quintana and Gallego did not disclaim the methods of neo-classicism. These methods still found acceptance with the young men who constituted the coterie of writers known as the School of Seville, but in the poetry of the guiding spirits among them, such men as Arjona, Lista, Blanco and Reinoso, there is also evident a respect for the older and purely Spanish literary tradition.

The Romantic movement which had swept Europe outside reached Spain somewhat belated in the fourth decade of the century. Liberal writers who had fled the land during the despotic rule of Ferdinand VII returned at his death in 1833 and helped efficaciously in spreading the evangel of Romanticism which had come to them in England and France. As understood by them Romanticism was the very antithesis of Classicism, in that it threw off all restraint and believed in giving unchecked expression to the feelings of the inner man, and, moreover, it sought inspiration in the Christian Middle Ages and not in pagan classic antiquity so favored by the classicists. Martínez de la Rosa (1787–1862), who is in many respects still a votary of Classicism, manifested clear tendencies toward Romanticism in his play 'La Conjuración de Venecia' (1834). A decided victory for the new doctrines was won in 1835 by the performance at Madrid of the play 'Don Alvaro' by the Duque de Rivas (1791–1865), who likewise introduced the Romantic spirit into the lyric with his 'Faro de Malta,' and into narrative poetry with his 'Moro Expósito.' The fervor of Romantic enthusiasm is patent in one of the most transcendentally lyrical of all Spanish poets, José de Espronceda (1809–42), who rose up rebellious to all social and literary convention and proved to be an apt, though not a servile, disciple of Byron, in his longer compositions, the 'Estudiante de Salamanca' and the 'Diablo Mundo.' The Romantic's love for mediæval traditions has full expression in the legends in verse of José Zorrilla (1817–93), who has, besides, achieved widespread popularity with his drama 'Don Juan Tenorio.' The Romantic ferment appears but slightly in the pieces of the prolific playwright, Bretón de los Herreros (1796–1873), who delighted rather in rendering pictures of living manners. The poetess and dramatist, Gertrudis de Avellaneda (1814–73) alternated Romantic and Classic moods. By the middle of the 19th century the realistic attitude prevailed over the Romantic and has done so ever since both on the boards and in prose fiction. The dramatists López de Ayala (1829–79) and Tamayo y Baus (1829–98) pictured vividly the corruption of manners induced by the exaggerated materialism and positivism of society and the business world. While the historical drama has a brilliant representative in the 'Haz de Leña' of Núñez de Arce (1834–1903), the theatre of recent times has not been marked by the appearance of works of great and lasting merit. At the moment, the *género chico* (one-act plays frequently farcical of plot) holds sway; still a really artistic endeavor is revealed in the more ambitious plays of Benavente and the Quintero brothers. Much praise can hardly be accorded to the dramatic attempts of the essentially novelistic genius, Pérez Galdós.

The splendid development given to the novel is the boast of the Spaniard of to-day. Out of essays on local manners as written by Larra, Miñano, Mesonero Romanos and Estébanez has grown the regional novel which portrays the life of southern Spain in the works of Fernán Caballero (Cecilia Böhl de Faber, 1796–1877), that of the north and of the capital in the stories of Pereda (1834–95), that of eastern Spain in the novels, often tracts, of Blasco Ibáñez, that of her Galicia in the fiction of the Countess Pardo Bazán (b. 1851), that of various places in the narratives of Palacio Valdés, and that of the whole land in the many psychological novels of Pérez Galdós. The last named has also cultivated the historical novel with extraordinary skill through four series of stories, each containing 10 novels, which cover the course of national events from the reign of Carlos IV down through the midpoint of the 19th century. Somewhat of the naturalism of Zola and the de Goncourt brothers is visible in the productions of one or another of these authors, but it is not usually carried to morbid extremes. Juan Valera (1824–95) can hardly be associated with the realistic novelists, and yet he is not an idealist; his geniality and sprightly fancy have won him many admirers. The number of the other writers of prose fiction that might be mentioned is simply legion. Perforce mention of them is omitted here, as also of the many prose writers who have gained well-merited praise for their historical and critical labors. Nevertheless, record must be made of the highly cultured and acute literary critic, the late Menéndez y Pelayo, and of the brilliant philologist, Menéndez Pidal. Notable among the lyricists since the middle of the 19th century are Bécquer (1837–70), whose beautiful poems are often pure music, and the cynically but not unpleasantly pessimistic Campoamor. Lyric verse and novels are constantly appearing in undiminished profusion. The events of the World War have provided scope for the imagination of Blasco Ibáñez in his 'Cuatro Jinetes del Apocalipsis' and his 'Mare Nostrum.' See AMADIS DE GAULA; CELESTINA, THE; DON QUIXOTE; POEM OF THE CID.

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SPANISH MACKEREL, a mackerel (*Scomberomorus maculatus*), with the body more compressed than that of the common mackerel and the head short and conical. It reaches a length of about 30 inches and is a handsome fish marked on the sides with round golden bronze spots which distinguish it at once from any other fish occurring in our waters. This mackerel is properly a tropical species, but during the summer migrates northward along the Atlantic Coast, occasionally reaching Cape Cod. It is one of the most graceful and active of fishes, and swims at the surface in schools in pursuit of menhaden, silversides and other smaller fishes, which constitute its chief diet. The species is very prolific, each female producing from 300,000 to 1,000,000 of the small buoyant eggs which develop rapidly and may hatch within a single day. In Chesapeake Bay, which is an important spawning ground, the breeding season is June. A favorite game-fish in the south, the Spanish mackerel is commercially of considerable importance, being excellent for table use. It was very little known before the introduction of the pound-net into our fisheries. Many mackerel are taken in these nets about Sandy Hook, but the most important fisheries are in Chesapeake Bay, where gill-nets are also employed largely in their capture. The sierra (*S. regalis*) and the silver cero or king-fish (*S. cavalla*) are related species found in the West Indies and along the coast of the South Atlantic States. Several fish found in southern waters are known as Spanish mackerel, the species to which the name is applied varying with the locality.

SPANISH MAIN, a name formerly given to the coasts of the Spanish colonies bordering on the Caribbean Sea, and often transferred to the sea itself. In the latter sense it occurs frequently in connection with the buccaneers. See BUCCANEERS.

SPANISH MOSS, an epiphytic, pendulous plant (*Tillandsia usneoides*) of the pineapple family, which is widely distributed throughout tropical America. The soft-hair seeds are carried by the wind to the rough bark of tree-branches, where they lodge and germinate. The stems are very slender, gray and scurfy, sometimes several feet long, bear scattered leaves which are narrowly linear and have in their axils solitary, regular and perfect three-parted flowers, which are yellow-petaled but inconspicuous. The plants are silvery gray in tone, which accounts for their common name of old man's beard; and they drape the forests extensively and mournfully, in contrast with the evergreen of pines and live oaks, as far north as the Carolina Coast. They are used after drying as packing for articles in boxes, stuffing for cheap mattresses, etc. See FIBRE.

SPANISH MUSIC. Spanish art and literature are characterized by the short duration of their flowering season. Two centuries — from 1500 to 1700 — include almost everything that is eminently important in these fields. Calderon, Lope de Vega, Cervantes, Velasquez and Murillo,— all belong to this period. It is also the period of Spanish eminence in music. Indeed, were it not for the fact that most of the composers who lived at this time developed their activities in Rome instead of their native country, we might even speak of a distinct Spanish school. As it is, the composers in question formed an integral part of what is known as the Roman school of church music,— culminating in the renowned Palestrina. The most important masters of Spanish origin connected with this school were Morales and Vittoria, both living in the 16th century. The former, a writer of great seriousness and elevation of style, was a predecessor of Palestrina in the Papal chapel and probably exercised considerable influence on his musical development. The latter was one of the most prominent successors of the great Roman composer. Indeed, the names of the two are often linked together, just as the men were intimate friends during their lifetime. Though not quite the equal of Palestrina in technical mastery and variety of expression, Vittoria has certain qualities of emotional depth and tenderness which are distinctively his own. Other eminent composers of early church music were Escobedo and Guerrero. Since the time of these masters there has been a decline in the cultivation of the musical art, and Spanish composers have taken but little part in the wonderful developments of opera and instrumental music of the last three centuries. However, their country has given the world some of its greatest teachers and reproductive artists, such as Garcia, Malibran, Sarasate and Patti. And in recent years there has been renewed activity in the field of composition which augurs well for the future.

It is to Spain that we owe two instruments which, though not of paramount importance, occupy a characteristic place in the family of musical mechanisms. We refer to the guitar and castanets. And it is to Spain, likewise, that we are indebted for some of the most characteristic dances in existence. Among these we may mention the fandango, bolero, cachucha, jota and seguidilla. The celebrity of these dances is justly deserved, for they are highly picturesque both by reason of the general appearance of the participants and on account of the unique nature of their movements, which are full of grace and animation. The accompanying music is generally in triple time and is likewise characteristic, especially in its rhythm. Indeed, the Spanish dance has now settled into a distinct type of composition and is considerably used by composers as a vehicle of expression. We need but refer, in this connection, to Moszkowski's celebrated dances. All in all, the Spanish dance may be regarded as the most important contribution which has been made by the Iberian Peninsula to the music of to-day.

Albert Gehring.

SPANISH PEAKS, two isolated mountains which form prominent landmarks in southern Colorado, near the Mexican border. The summit of the higher peak is 13,623 feet above sea-level. It is partly composed of volcanic rocks. The other mountain is 12,720 feet high.

SPANISH REFORMED CHURCH, a church organization founded in Spain in 1869. The movement originated with the native Spaniards, but was assisted by English and Irish Episcopalians, who in 1867 founded the Spanish and Portuguese Church Aid Society. The church of the Redeemer was established at Madrid under its auspices in 1869, and later 10 other churches were established under the name of the Spanish Reformed Church. The first bishop of the church was Juan Bautista Cabrera, who was consecrated to his office by the archbishop of Dublin in 1887. There are now more than 20 congregations, of which the most important are those at Madrid, Valladolid, Salamanca, Malaga and Seville. The Church is governed by a synod composed of both the clergy and of laymen. Its doctrines follow those of the established creeds with perhaps the greatest similarity to the Episcopal Church.

SPANISH SUCCESSION, War of the. See Succession Wars.

SPANISH TOWN, or SANTIAGO DE LA VEGA, town in Jamaica, on the Cobre River, 10 miles west of Kingston, with which it is connected by railroad. It is the second town in importance on the island; was founded by Diego Columbus in 1525 and was formerly the capital; but the seat of government was moved to Kingston in 1871. Pop. about 8,500.

SPANISH WAR VETERANS, a society organized by men who took part in the Spanish-American War. The object of the society, which was incorporated 28 Nov. 1899, is to keep alive the memories of the war with Spain in a patriotic American sense and not with the view of nursing any feeling of international enmity, to promote the best interests of those who took part in the war in the service of the United States and to encourage universal liberty and equal rights and justice. Although the number of killed and wounded in the Spanish War was not large, as compared with other wars in which the United States has been engaged, the character of climate and the season of the Cuban campaign were such as to do permanent injury to thousands of veterans not wounded in battle, while many suffered serious detriment to health who never passed beyond the Southern camps. This society was united in 1904 with the Society of Spanish American War Veterans, the Society of the Service Men of the Spanish War and the Society of the Hispano-American War, and is known as the «United Spanish War Veterans.» It concerns itself with the interests also of those who participated in the Philippine campaign and the Chinese Expedition.

SPANISH WAR VETERANS, National Auxiliary of, an association composed of the mothers, wives, sisters and daughters of members of the Society of Spanish War Veterans, also of other women, such as nurses, who rendered special service during the war in camp or hospital or otherwise.

SPAR, a general name in mineralogy for a crystalline mineral which is not an ore easily cleavable. Thus we have feldspar, comprising both orthoclase and plagioclase; calcspar or cleavable calcite, with its transparent variety iceland spar; fluor spar or fluorite; satin spar, or fibrous gypsum; tabular spar, or Wollastonite and heavy spar or barite. The term is of German origin.

SPARGO, John, American author: b. Stithians, Cornwall, England, 31 Jan. 1876. He was educated in the public schools and under the University extension courses of Oxford and Cambridge. At the age of 18 he became identified with the Socialist movement in England; he publicly opposed the Boer War and in 1901 came to the United States, where he has been active as Socialistic lecturer, writer and worker. In 1910 Mr. Spargo was United States delegate to the International Socialist and Trade Union Congress, Copenhagen. For several years he served on the national executive committee of the Socialist party; was delegate to all leading conventions of the party; and State chairman of Vermont. In May 1917 soon after the entry of America in the war with Germany, Mr. Spargo resigned from the party because of its unpatriotic attitude toward the war. In 1918 he was made temporary chairman of the National Socialist party organized along new lines that year and became director of propaganda and of educational activities in the new party. Mr. Spargo is a founder of Prospect House Social Settlement, Yonkers, N. Y., and is a member of the New York Milk Commission and of other philanthropic societies. He has published ‹The Bitter Cry of the Children› (1906); ‹Socialism, a

Study and Interpretation of Socialist Principles' (1906; rev. ed., 1909); 'The Socialists, Who They Are and What They Stand For' (1906); 'Underfed School Children' (1906); 'Forces that Make for Socialism in America' (1906); 'Capitalist and Laborer' (1907); 'Not Guilty,' a drama (1907); 'The Common Sense of the Milk Question' (Japanese and other translations 1908); 'The Common Sense of Socialism' (1908); 'The Socialism of William Morris' (1908); 'The Spiritual Significance of Modern Socialism' (1908); 'Socialist Readings for Children' (1909); 'The Substance of Socialism' (also Armenian and other translations, 1909); 'Karl Marx, His Life and Work' (1909); 'The Marx He Knew' (1909); 'Sidelights on Contemporary Socialism' (1910); 'Elements of Socialism,' with Professor Arner (1911); 'Applied Socialism' (1912); 'Syndicalism, Industrial Unionism and Socialism' (1913; various translations); 'Socialism and Motherhood' (1914); 'Marxian Socialism and Religion' (1915); 'Socialism and Internationalism' (1917); also numerous pamphlets, brochures and magazine articles on social and economic questions and art. With Samuel Gompers he founded the American Alliance for Labor and Democracy in September 1917.

SPARIDÆ, a large family of carnivorous shore-fishes, the porgies, of tropical seas, especially abundant in the Mediterranean, Red Sea and West Indian waters. None is of great size. The body is oblong, likely to be elevated, covered with large adherent scales and ornamental colors; the mouth is filled with strong teeth, in which the incisors are prominent. Most of them are excellent food and many are gamy. Jordan says that about 11 genera and 100 species are counted in the family, about half of which occur in North American waters. These include the scup, porgies, sheepshead and related fishes. Consult Goode, 'American Fishes' (New York 1888); Jordan and Evermann, 'Fishes of North and Middle America' (Washington 1898).

SPARKLING WINE. See WINE AND WINE MAKING.

SPARKS, Edwin Erle, college president and American historical writer: b. Licking County, Ohio, 1860. He was graduated from the Ohio State University in 1884 and from the University of Chicago in 1900. He was instructor at Ohio State University 1884–85; professor at Pennsylvania State College 1890–95; lecturer before the American Society of University Extension 1893–95; professor of American history at the University of Chicago from 1895 to 1908; and since that date president of the Pennsylvania State College. He has published 'Expansion of the American People' (1899); 'The Men Who Made the Nation' (1900); 'Formative Incidents in American Diplomacy' (1902); 'The United States' in the 'Story of the Nations Series' (1903); 'Foundations of National Development' (1907); 'The Lincoln-Douglas Debates' (1908); and many contributions on educational administration subjects.

SPARKS, Jared, American scholar and historian: b. Willington, Tolland County, Conn., 10 May 1789; d. Cambridge, Mass., 14 March 1866. He was graduated from Harvard in 1815, studied theology with Dr. Nathaniel Thayer from May 1817 to March 1818, was editor of the *North American Review*, then begun in Boston, and in 1818 entered the Unitarian ministry. On May 1819 he was ordained pastor of the Unitarian congregation at Baltimore, Md., Dr. W. E. Channing (q.v.) preaching on that occasion the well-known discourse of 'Unitarian Christianity.' Sparks did much in Baltimore to promote the growth of the Unitarian faith, instituting there a Unitarian book society and editing the *Unitarian Miscellany*, a monthly periodical. He resigned in 1823 and from 1823 to 1830 was again editor of the *North American Review*, in which he acquired a three-quarter interest. After some periodical contributions to the economic history of the South, and to Mexican and South American history, he published in 1828 a 'Life of Ledyard,' the American traveler. In the preparation of this work he first undertook that method of travel and research among original sources in which he was the pioneer in the United States and which he afterward so worthily applied to the study of American history. After long investigation, including a very wide correspondence and a voyage to Europe for the examination of records in the public offices of London and Paris, he published the well-known 'Writings of George Washington, with a Life of the Author, Notes and Illustrations' (1834–37), which remained the standard until partially superseded by W. C. Ford's edition (1889–93). Sparks used the copies of Washington's letters as found in the latter's letter-book. The discrepancies found to exist between the copies and the originals as preserved refuted the charges at first made to the effect that Sparks had wilfully altered the letters. Sparks' method of editing in general has, however, been discarded. He printed only what he believed of importance, omitting and altering passages as he saw fit. This was largely due to the idea of editorial discretion then observed, and should not be made occasion for disparagement. Whatever may be said of his methods in editing text, Sparks was a really distinguished historical scholar and maintained almost invariable as high a level of excellence as was then possible to the historical editor. He also prepared 'The Works of Benjamin Franklin' (1836–40); 'The Library of American Biography' (1st series 1834–38; 2d 1844–48), himself writing seven of the 60 lives; and 'Correspondence of the American Revolution' (1854). He also wrote 'Remarks on American History' (1837). He was professor of history at Harvard in 1839–49, and president in 1849–53. The standard biography is Adams, H. B., 'Life and Writings of Jared Sparks' (Boston 1893); there is also one by Ellis (1869). Consult also Bassett, J. S., 'Jared Sparks' in 'The Middle Group of American Historians' (New York 1917).

SPARKS, Nev., city in Washoe County, on the Truckee River, three miles east of Reno, and on the Southern Pacific Railroad. It has important railroad shops and ranks as a railroad town. It is closely connected with Reno by car lines. There is a high school and a public library. Pop. 2,500.

SPARROW, the familiar name of many small birds of the finch family (*Fringillidæ*), applied loosely to the representatives of a large and varied assemblage of genera. Generally speaking, sparrows are moderate-sized members of the family which live mostly on or near the ground, whose bills are neither especially short and stout nor angulated in the gape, and which have the sexes similarly colored. About 10 genera and 40 species called sparrows belong to the North American faunas of which the following may be mentioned. The white-crowned sparrow (*Zonotrichia leucophrys*) is about seven inches long, the body stout, and the tail rather long and moderately rounded; the chin, throat and breast are nearly uniform ashy; the head above black; median and superciliary stripe pure white; a narrow black line through and behind the eyes; back and wing-coverts dark reddish brown with paler margins; quills and tail darker; wings with two white bands; whitish below; bill reddish orange tipped with brown. It is found from the Atlantic to the Rocky Mountains and from Labrador to Texas, breeding to the north and in the Rocky Mountains. The notes are mellow and sweet, six or seven in number, the first loud and clear, and then becoming fainter and more plaintive; eggs light green with brownish mottlings at the larger end. The nest is on the ground or among moss, and the eggs are laid in Labrador from the 1st to the end of June. The flight is low and swift; the migrations are performed mostly by day; the food consists of seeds, berries and insects. It spends its summers in northern Canada and Alaska. The white-throated sparrow or peabody bird (*Z. albicollis*) has the chin abruptly white; superciliary stripe broad, yellow anteriorly and white behind; median head-stripe white, with a black one on each side, and a broad black streak behind the eye; edge of wing and axillaries yellow; two narrow white bands across wing coverts. It is found in the eastern United States and westward to the Missouri, appearing in the Southern States in November and departing in March to the North. It breeds from the northern tier of States northward, and its nest, eggs and song resemble those of the last mentioned. This species is very active among hedges and thickets, and is found in flocks with the white-crowned sparrow, than which it is generally more plentiful. These, with two or three additional western species of *Zonotrichia*, are among the largest and most handsome of our sparrows.

The genus *Spizella*, which differs from the last in its smaller size and longer forked tail, contains three well-known northern species and as many more confined to the western and southern United States. The field sparrow (*S. pusilla*) is about five and one-half inches long; the bill is reddish; ear coverts, crown and back rufous, the last with blackish streaks; sides of head and neck, and stripe over eyes, ashy; white below, tinged with yellow anteriorly; quills and tail faintly edged with white, and two bands of the same across wing coverts; rump yellowish brown. It is found in eastern North America as far as the Missouri, remaining in the Southern States during winter, going north in March, and arriving in New England toward the last of April. The song is pleasing, resembling the trill of a young canary. It is sociable and peaceful, and very prolific, sometimes raising three broods a year. The nest is of grasses and placed on or near the ground; the eggs usually four or five, whitish, thickly speckled with reddish brown. It frequents fields and fence rows, and flocks when not breeding. The chipping-sparrow (q.v.) and tree-sparrow belong here. The genus *Passerella* is remarkable for the elongation of the lateral toes and the large size of the claws, adapting these birds for scratching on the ground. The fox-colored sparrow (*P. iliaca*), with its several varieties, is our only representative. It is seven inches long, the back is rust brown, margined with ashy, lighter on the head, tail and wing coverts, rufous on the last two; white below, streaked with light brownish red on breast and sides of neck, rufous patch on cheeks. It is found as far west as the Mississippi, preferring the Northern States and going south in winter. It is seen in small flocks in the underwood and along brier-skirted fences and streams. It breeds in British America. The flight is slow, rapid and undulating; the song clear, full, sweet and prolonged with many repetitions. The nest is made on the ground or in bushes.

Other important genera are *Ammodramus*, with 11 species, including the savanna sparrow (*A. sandwichensis*), the yellow-winged grasshopper sparrow (*A. passerinus*), the sharp-tailed sparrow (*A. caudacutus*), and the seaside sparrow (*A. maritimus*), the last two inhabitants of salt marshes, *Melospiza*, including the song sparrows (q.v.); *Poöcætes*, with the vesper sparrow or bay-winged bunting (*P. gramineus*); and others less well-known. The sparrows of Europe are few in number and belong to the genus *Passer*. Besides the house sparrow, the European tree-sparrow (*P. montanus*) has been introduced into this country. There is also an American bird of the same name, also called Canada sparrow (*Spizella monticola*), which much resembles the chipping-sparrow, but has a distinct dark spot on the breast and conspicuous white wing-bars. It is a northern bird, but in the winter is abundant in the United States, flocking in fields and shrubbery.

Consult: Ridgway, 'Birds of North and Middle America,' Part I. (Washington 1902); Forbush, 'Useful Birds and Their Protection' issued by the Massachusetts Board of Agriculture (1913); and general works on ornithology. For the "English" sparrow, see HOUSE-SPARROW.

SPARROW-HAWK, a small falcon (*Falco sparverius*), common throughout North America and practically cosmopolitan, since scarcely distinguishable species inhabit all quarters of the globe. It is 11 to 12 inches long, and the adult male has the back tawny; wings bluish and black; seven black blotches about the head; tail chestnut, with a broad black band and a narrow terminal one of white; below white or tawny. The female is more streaky, has the tail tawny with numerous narrow, darker bars; back and wing-coverts rusty, barred with black. These birds are true falcons (see FALCONRY), and admirably bold and active. Not infrequently the sparrow-hawk may be seen to attack other and larger birds of prey, its courage extending even to recklessness, while it is also shy and wary. It feeds largely on mice, which it catches with great skill, and also sometimes seizes young chickens, but its depredations in that direction are of little consequence. It makes its nest in hollows of trees, the deserted hole of a large woodpecker, or sometimes an abandoned crow's-nest.

SPARROW-OWL, one of the diminutive, brown-streaked owls of the genus *Nyctale*, of which the saw-whet (q.v.) is a familiar example. The name belongs primarily to Tengmalm's owl of Northern Europe, of which Richardson's own (*N. richardsoni*) of Canada and Alaska is an American variety. It is bold and strong, and feeds mainly on small birds.

SPARTA, spär'ta, a celebrated city of ancient Greece, the capital of Laconia and of the Spartan state, was situated on the west bank of the river Eurotas, and embraced a circuit of six miles. Sparta was irregularly built, and from this circumstance it is supposed to have got its name, signifying «scattered.» It consisted of five separate quarters, which were not completely surrounded by walls till the time of the Romans. It was the boast of Sparta that her men were her walls. Among other remarkable objects enumerated by Pausanias are the following: the market-place, containing the public buildings, in which the council of the elders held their meetings, and the principal ornament of which was the Persice, a celebrated colonnade, built from the spoils taken from the Persians, its roof being supported by statues of Persians; the theatre, the remains of which constitute the principal ruins of Sparta; the Choros, or place in which the ephebi executed their dances, adorned with statues of Apollo, Artemis and Leto; the Leschai, or halls in which the popular assemblies were held, and of which there were two — the Lesche of the Crotanes, near the tombs of the Agides, and the Lesche Pœcile; the Temple of Athene Poliouchos or Chalkioikos (as the goddess was commonly called, from the bronze ornaments of her temple), on a steep hill, to which the Spartans gave the name of the Acropolis, etc. Sparta was the name of the city during the period of its historical celebrity. Lacedæmon is found in Homer as the name both of the city and the territory, but it afterward dropped out of use, and does not appear to have been revived till several centuries after Christ. Laconia, the district in which Sparta was situated, was the southeastern division of the Peloponnesus, bounded on the west by Messenia, from which it was separated by the chain of Taygetus, on the north by Arcadia and Argolis and on the east and south by the sea. The principal towns in Laconia besides Sparta were Amyclæ and Pharis, both situated like Sparta on the west bank of the Eurotas, a little lower down.

The Spartans were the descendants of the Dorians who invaded the Peloponnesus about 80 years after the siege of Troy, and from an early period they conformed to a set of rigorous institutions aimed at making them a purely warlike nation. These institutions they themselves ascribed to Lycurgus, who, if he was really a historical character, must have lived not later than the 9th century. It is probable that shortly after their settlement in the Peloponnesus the Spartans extended their sway over all the territory of Laconia, the inhabitants of which they reduced partly to the condition of Helots and partly to that of Periœci. The former were completely enslaved, bound to the land which they had to till for their masters, and required to serve the state in war. The latter were free, possessing land of their own, and carrying on trade and practising the arts, both of which pursuits were forbidden to Spartans. The next great wars of Sparta are usually regarded as the direct consequence of their new institutions. They were waged with the Messenians in the 8th and 7th centuries B.C., and resulted in 668 B.C., in the complete subjugation of the Messenians, who were either compelled to leave their country or were reduced to the condition of Helots. Wars were also carried on against their northern neighbors, the Arcadians and the Argives, against both of whom they were successful, and before the close of the 6th century B.C., they not only stood at the head of the states of the Peloponnesus, but were even recognized as the leading people in all Greece. Early in the following century began the Persian wars, in which Sparta played a conspicuous part, but the details down to the conclusion of the Peloponnesian War in 404 B.C. belong to the common history of Greece, to which the reader is referred. The events of the wars with Persia led to Sparta being supplanted by Athens as the leading state in Greece; hence arose a jealousy between the two cities which ultimately brought on a war, in which the one-half of Greece was divided against the other, and this war, the Peloponnesian, ended in the ascendency of Sparta and the entire humiliation of her rival. The rivalry of the Spartan general Lysander and the king Pausanias soon after produced a revolution, which delivered the Athenians from the Spartan yoke (403). A little later the Spartans became involved in a war with Persia, by joining Cyrus the Younger in his rebellion against his brother Artaxerxes Mnemon (401). The war was continued even after the failure of the enterprise of Cyrus, and the Persian throne was shaken by the victories of Agesilaus; but Athens, Thebes, Corinth and some of the Peloponnesian states took this opportunity to declare war against the Lacedæmonians. The latter defeated the Thebans at Coronea (394); but, on the other hand, the Athenian commander Conon gained a victory over the Spartan fleet at Cnidus. This war, known as the Bœotian or Corinthian War, lasted eight years, and increased the reputation and power of Athens. To break the alliance of Athens with Persia, Sparta, in 387 B.C., concluded with the latter power the peace known by the name of Antalcidas; and the designs of Sparta became apparent when she occupied, without provocation, the city of Thebes, and introduced an aristocratical constitution there. Pelopidas delivered Thebes, and the celebrated Theban War (378–363) followed, in which Sparta was much enfeebled. During the following century Sparta steadily declined, although one or two isolated attempts were made to restore its former greatness. The principal of these was made by Cleomenes (236–222), but his endeavors failed, because there were then scarcely 700 of Spartan descent, and the majority of these were in a state of beggary. With the rest of Greece Sparta later passed under the dominion of the Romans in 146 B.C.

The Spartans differed from the other Greeks in manners, customs and the constitution of their state. Their kings (two of whom always reigned at once) ruled only through the popular will, acting as umpires in disputes and commanding the army. The Spartans proper, that is, the descendants of the Dorians, occupying themselves with war and the chase, left all ordinary labor to the Helots, while the class known as Periœci engaged in commerce and manufactures.

SPARTA, Ill., city in Randolph County, 45 miles southeast of Saint Louis, on the Illinois Southern and the Mobile and Ohio railroads. There are coal mines in the vicinity, and industries include railroad repair shops and manufactures of plows and harrows, flour and planing-mill products. Pop. 3,081.

SPARTA, Wis., city, capital of Monroe County, on the La Crosse River, and on the Chicago, Milwaukee and Saint Paul and the Chicago and Northwestern railroads, about 23 miles northeast of La Crosse. It is a favorite summer resort. It is in an agricultural and fruit-growing region. It has flour and feed mills, machine shops, paper mills and cigar factories. The educational institutions are a high school, public and parish elementary schools, and a public library. The city contains several churches and the State School for Dependent Children, and the Hospital for the Insane is a short distance north. The three banks have a combined capital of $100,000. Sparta was first settled in 1851, was incorporated as a village in 1857, and as a city in 1883. It is governed by a mayor and a council of eight, elected biennially. Pop. about 4,000.

SPARTACANS, or **SPARTACIDES**, is the name acquired soon after the going into effect of the armistice accorded Germany in Nov. 1918, by the special followers of Karl Liebknecht (q.v.), leader of the extreme left wing of the German Socialist party, or Independents, notably during the several risings of the latter against the moderate, or majority, Socialists under the leadership of Ebert and Scheidemann, who had formed a composite government from which the Spartacans had withdrawn as not realizing their political and economic ideals. There were several of these organized, or centralized, risings, the more considerable occurring in January 1919, when in Berlin alone the deaths in the fighting on both sides were computed at sundry thousands, and quite a number of local and insufficiently organized ones in various parts of Germany, such as Halle, Brunswick, Leipzig, Dresden, Hamburg, Bremen, Duisburg and other places. The communistic uprising in Munich, on the other hand, which occurred during March and April 1919, does not properly figure under the head of Spartacan undertakings. The name of «Spartacan» originated from the pen name of Karl Liebknecht, «Spartacus,» which he had adopted while being held prisoner by the former German imperial government during the last two years of the Great War, 1916–18, for his clandestine articles appearing in the press of the left wing of the Socialist party, notably *Die Freiheit*. The genesis of the Spartacans, however, ought to be traced to the very beginnings of the Great War, to August 1914, when the extreme wing of the great Socialist party in Germany first showed signs of a desire to secede from the party as a whole, as being unalterably opposed to the whole war which they deemed as being engineered by capitalistic and militaristic influences and, therefore, to be condemned *in toto*. This desire not long after they carried out openly, constituting themselves as a new party in the Reichstag, in opposition to all others, and refusing throughout the remainder of the war to vote for supplies and funds to sustain it. When the split took place, out of a total of 108 party members in the Reichstag, 19, subsequently increased to 23, left the Socialist party and called itself the Independent. After the rather tame revolution that ousted the kaiser in the beginning of November, 1918, and led to the overturn of the whole imperial régime and the armistice itself, this Independent, or as later denominated, Spartacan, party veered further to radical tenets, becoming, in fact, communistic, even occasionally anarchistic, in its aims and practices, and not only leaning to, but affiliating with, the Bolshevist party of Russia. Karl Liebknecht himself aided in this molting process, but was murdered in the streets of Berlin, together with his ablest lieutenant, Rosa Luxemburg (q.v.), before the full development of that party movement. The adoption of the title of Spartacans has been considered by many a rather curious thing, since the rising of the Roman slaves under Spartacus came to a speedy evil end and left no trace behind it.

WOLF VON SCHIERBRAND.

SPARTACUS, spär'tą-kŭs, Roman insurrectionist: b. Thrace: d. Lucania, 71 B.C. He was captured by the Romans, sold as a slave, and trained as a gladiator at Capua. Here he headed a fight for freedom and succeeded, with 70 comrades, in reaching the crater of Vesuvius, where he was soon joined by other fugitives. His force quickly grew to large proportions and he gained several battles. Spartacus now proclaimed the abolition of slavery, and, being joined by the slaves of the South, passed Rome with a victorious army of about 100,000 men and advanced into the region of the Po. His plan was to lead his army out of Italy and disband it, so that the freed slaves might return to their homes. Despite dissensions and disaffections which arose, he successively met and defeated the two consuls sent against him (72 B.C.). But the slaves, flushed with success, refused to follow their leader out of Italy and demanded to be led against Rome. Spartacus therefore conducted them into winter quarters at Thurii, where Licinius Crassus was sent against him. Having defeated two legions of that general's command, he broke through the obstacles which Crassus had interposed and marched toward Rome. He was overtaken, however, and owing to the dissensions in his army was defeated. Attempting to cross into Sicily, he was betrayed by Sicilian pirates and a portion of his army was captured by Crassus. With the remainder Spartacus won new victories, but in a decisive battle with Crassus on the river Silarus his army was annihilated, Spartacus himself being slain.

SPARTANBURG, S. C., city and county-seat of Spartanburg County, situated at the foot of the Blue Ridge Mountains, on the main line of the Southern Railway, and on the Charleston and Western Carolina, the Carolina, Clinchfield and Ohio, and the Piedmont and Northern railroads, about 100 miles northwest of Columbia. The city is within a few hours of the great eastern markets and the coal fields of Tennessee, Virginia, West Virginia and Kentucky. It is an agricultural region in which cotton is the principal product. It has an agreeable climate, without extremes. The average annual rainfall is 54 inches and the average temperature 51° F. The educational institutions include Wofford College for Young Men; Converse College for Young Women; Cecil's Business College; several private schools and a first-class public school system. The city is the home of the South Atlantic States Music Festival. It has 100 miles of paved sidewalks and 16 miles of paved streets. The eight city banks have combined resources amounting to $11,400,000; postal receipts in 1917–18 amounted to $338,000, due to the proximity of Camp Wadsworth, where 125,000 soldiers were trained. The tax valuation of the city is $10,000,000, an increase of 34 per cent since 1915. The city has a fine Y. M. C. A. building, Y. W. C. A., several churches, five hospitals and several clubs.

Spartanburg County ranks first in South Carolina in invested capital and value of annual products of industrial concerns, nearly all of which are located in Spartanburg. The average cotton crop is 68,000 bales, while 147,000 bales are manufactured. There are 27 mill corporations operating 36 mills, with 834,000 spindles and 20,600 looms. The value of the manufactured product is $35,000,000. The capital invested amounts to $14,600,000. The city has excellent hotels, two of which are modern fireproofed structures. The city has adopted the commission form of government. The site of Camp Wadsworth, embracing 1,350 acres with perfect water and sewerage systems, has been purchased from the government and is being offered for suburban homes and industrial development. There is a municipally owned water-system in Spartanburg, with a capacity of 10,000,000 gallons. Pop. within corporate limits, 25,000; including suburbs, 35,000.

SPARTEINE (derived from the Latin *spartum* and the Greek *σπάρτον*, Spanish broom), an alkaloid discovered by Dr. Stenhouse in 1851, and obtained from the tops of the broom-plant. It is a thick, colorless, transparent oil, with a peculiar, unpleasant odor and a very bitter taste. It boils at 288°, is strongly alkaline, slightly soluble in water, very poisonous, and resembles nicotine in its compounds. Its sulphate is used in medicine as a cardiac stimulant.

SPARTEL, spär-tĕl', **Cape**, Morocco, Africa, the northwestern extremity of the continent. It is a promontory 1,030 feet high, situated at the western entrance to the Strait of Gibraltar.

SPARTINA. See GRASSES IN THE UNITED STATES.

SPASM, an involuntary, convulsive contraction of a muscle or set of muscles which is of a more or less tonic or prolonged character. When similar involuntary contractions are intermittent or clonic in character they are called convulsions. Convulsions usually imply some disturbance of the motor cortex of the brain. Spasms are generally of purely local origin; they are cramps. Spasms are sometimes held to be synonymous with tics (q.v.). In this sense it is the more modern distinction to regard spasm as a local irritant reflex act, convulsion an involuntary cortical reaction, and tic a muscular movement, originally voluntary, but become involuntary by frequent repetition. The word spasm, however, is used in all three conditions. Spasms occur in many forms of nervous disease, particularly in chorea, hysteria, hiccough, hydrophobia (q.v.), etc. The so-called facial spasm is a form of tic; bronchial asthma is a purely spasmodic affection of the muscular tissues of the bronchi; whooping-cough is largely spasmodic in its character.

SPASMODIC SCHOOL, in literature, a name applied in England to a group of English poets about the middle of the 19th century, among whom were Philip James Bailey, Sydney Dobell and Alexander Smith. The name implied the use of an overstrained and unnatural sentiment and expression, which sometimes grew out of sheer affectation.

SPAULDING, Rolland Harty, American public official: b. Townsend Harbor, Mass., 15 March 1873. He was educated at Phillips Academy, Andover; engaged in the manufacturing business in 1895, and is now member of Jonas Spaulding Sons, manufacturers of leatherboard, counters, novelties, etc., at Townsend Harbor, Mass., Rochester, North Rochester and Milton, N. H., and Tonawanda. Mr. Spaulding is also interested in several other manufacturing enterprises. He served as delegate to the Republican National Convention in 1912 and was governor of New Hampshire in 1915–16. In 1918 he was a candidate for United States senator.

SPAVIN, a disease of horses affecting the hock-joint. It occurs under two principal forms. In young, weakly or overworked horses the hock-joint is sometimes distended with dark-colored thickened synovia or joint-oil. This is bog spavin. Fomentations, occasional friction, a laxative diet, and rest should be diligently tried; and if such remedies prove unsuccessful the swelling must be dressed with strong blistering ointment or fired. The second variety, bone-spavin, is the more common. Toward the inside of the hock, at the head of the shank-bones, or between some of the small bones of the hock, appears a bony enlargement. At first there is tenderness, with heat, swelling, and considerable lameness; but as the inflammation in the bone and its investing membrane abates, the lameness may entirely disappear, or but a slight stiffness may remain. In recent and slight cases cold water should be applied continuously; but in serious cases, when the part is swollen and tender, hot fomentations are best. For several days they must be perseveringly employed. When the part is again cool and free from pain an iodide of mercury or fly-blister should be applied, and the animal treated to three months' rest in a small paddock, the end of a barn, or a roomy box-stall. In persistent cases firing or setoning usually gives much relief.

SPAWN, the eggs or ova of fishes, frogs and other of the larger aquatic animals. See EGG, and the names of various animals.

SPAWN-EATER, a local name for one of the commonest of brook-minnows or shiners (q.v.) (*Notropis hudsonius*), which is likely to eat the eggs of other fishes.

SPEAKER, one who presides over a deliberative assembly, preserving order, and regulating the debates; as, the speaker of the House of Representatives, the speaker of the House of Commons, etc. The Speaker of the House of Representatives is chosen by ballot from among the members upon the assembling of Congress, and occupies that office till the expiration of the body by adjournment *sine die.* If an extra session be called there is no new election of speaker, the same officer presiding over the deliberations. The presiding officer in the Senate is styled the president of the Senate, and he is not elected by that body, the office being held ex officio by the Vice-President of the United States. The speaker of the House of Representatives exercises large influence on legislation, and representing, as he does, the majority in Congress, he is usually sustained. The speaker of the British House of Commons receives a salary of £5,000 a year, with a furnished residence. He is a member of the Privy Council, and ranks after the barons. On vacating his post he receives a pension of £4,000 and is raised to the peerage. The first time a speaker was appointed by this title was in the reign of Edward III, when Sir T. Hungerford was elected. On the Continent of Europe the presiding officer of a legislative body is commonly designated by a title meaning "president." See UNITED STATES — SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SPEAKING TRUMPET, a metallic instrument of a somewhat conical form used for conveying the sound of the voice to a distance. The advantage of the conical form is satisfactorily explained on the assumption that waves of sound are reflected in the same way as rays of light, the angle of incidence and the angle of reflection being the same; for on this assumption it is evident that waves of sound proceeding from the narrow to the wide end of a truncated cone, from the walls of which they are reflected according to the law referred to, will gradually make smaller angles with the axis of the cone; or in other words, the direction of the sound will gradually become more nearly parallel to that axis. A cylindrical tube of uniform diameter has not the same effect, and accordingly is of no use in determining the direction of sound after it leaves the tube, although, as is seen in the case of speaking tubes used in offices, industrial establishments and private houses, it is of great service in transmitting sound from one extremity to the other. Speaking-trumpets are chiefly used at sea, especially in windy weather, to convey commands from one part of the ship to another, and sometimes to speak with another ship.

SPEAR, Charles, American philanthropist and author: b. Boston, Mass., 1 May 1801; d. Washington, D. C., 18 April 1863. After several years' service as a Universalist minister in Brewster and Rockport, Mass., he settled in Boston, where he became well known by his advocacy of prison reform, and his efforts to secure the adoption of legislative measures for the benefit and reformation of prisoners. He visited penal institutions; made suggestions for the more humane treatment of convicts, housed many of them when discharged, and was active in securing employment for them and in promoting their spiritual welfare. He died of an infectious disease contracted in Washington during the Civil War while seeking to ameliorate the condition of prisoners of war. He was a regular contributor to several religious periodicals, was editor of 'The Prisoner's Friend' (1848–54); and was the author of 'Names and Titles of Christ' (1842); 'Plea for Discharged Convicts' (1844); 'Voices from Prison' (1849), etc. Consult Catharine Swan Brown, 'Life of Charles Spear' (1888).

SPEAR, Ellis, American soldier and government official: b. Warren, Knox County, Me., 15 Oct. 1834. He was educated at Bowdoin College, graduating in 1858. During the Civil War he served in the national army, rising from the grade of a captain of Maine volunteers to colonel and commanding a regiment in the Army of the Potomac from 1863 to 1865. He was conspicuous as major commander of a brigade at Peebles Farm and was made colonel for his bravery in action. In 1865 he was brevetted brigadier-general, became inspector of division, and before the close of the war was given the command of a brigade. At the end of the war he became identified with the United States Patent Office, and became commissioner of patents (1877–78).

SPEAR, James, American manufacturer: b. Mauch Chunk, Pa., 17 Feb. 1827; d. Wallingford, Pa., 30 Jan. 1902. He engaged in the manufacture of stoves in Philadelphia, 1848, invented various improvements in heating appliances, among them the anti-clinker grate now generally used, and he also invented the first practical car-heater. He was one of the founders of the Hayes Mechanics Home, a benefactor of various institutions, particularly the University of Pennsylvania, and was actively interested in the Blind Men's Home.

SPEAR, Samuel Thayer, American Presbyterian clergyman and author: b. Ballston Spa, N. Y., 4 March 1812; d. Brooklyn, N. Y., 1 April 1891. He studied medicine, graduating in 1833 at the New York College of Physicians and Surgeons, but entered the ministry in 1835, after training at Troy, N. Y. After a pastorate at Lansingburg, N. Y., he was in charge of the South Presbyterian Church of Brooklyn, N. Y., from 1843 to 1871, when he became connected with the editorial staff of 'The Independent.' He was author of several works, including 'Religion and State' (1876); and 'The Bible Heaven' (1886).

SPEAR, a weapon of offense, consisting of a wooden shaft or pole varying in length up to eight or nine feet, and provided with a sharp piercing point. The spear may be regarded as the prototype of the various forms of piercing weapons, such as the arrow, bolt and dart, which are projected from bows, catapults or other engines, and the javelin, assegai and lance, held in or thrown by the hand. The longer and heavier spears and lances are mainly retained in the hand while in use, but there is no absolute distinction. and the throwing of a spear has in all ages been a form of offensive warfare.

In its earliest form the spear would naturally consist of a simple pole of tough wood sharpened to a point at one extremity, which point might be both formed and hardened by charring in fire. From this an improvement would consist in fitting to the shaft a separate spear head of bone, as is still practised among primitive races.

The war lance of the mediæval knights was 16 feet long; the weapon of modern cavalry regiments known as lancers may be from 8½ to 11 feet long, usually adorned with a small flag near the head. The Persians at the present day forge spear heads for ornamental purposes only, with two and sometimes three prongs. The modern spears of savage tribes, used equally for hunting and for warlike purposes, are frequently barbed with fish and other bones, and their fighting spears have sometimes poisoned tips. Among civilized communities the hunting spear continues to be used for following the wild boar and other large game, while the Cossacks of Russia and various corps in the armies of western Europe are armed with spears or lances, which experience has shown to be efficient weapons for cavalry. The spear was not an ordinary weapon among the North American Indians, who, before the introduction of the musket among them, used the bow and arrows and the tomahawk.

SPEARFISH, S. Dak., city in Lawrence County, 10 miles northeast of Deadwood, on the Chicago, Burlington and Quincy Railroad. It has a high school and is the seat of a State normal school. The surrounding region is devoted to fruit and stock-raising. There are manufactures of flour and lumber products, a stucco mill and cyanide plant. Pop. 1,130.

SPEARFISH. (1) One of the carp-suckers (q.v.), a species (*carpiodes velifer*) of the Mississippi Valley; (2) a large deep-sea, predatory fish of the warmer parts of the Atlantic allied to the sailfishes (q.v.), and placed in the genus *Tetrapturus;* the best-known species is the billfish (*A. imperator*), called aguja by Spanish-speaking fishermen.

SPEARMAN, Frank Hamilton, author, b. Buffalo, N. Y., 6 Sept. 1859. He was educated at public and private schools in Appleton, Wis., and at Lawrence College. He engaged for some years in commercial life; then from 1895 devoted himself to literary work. He is the author of 'The Nerve of Foley' (1900); 'Held for Orders' (1901); 'Doctor Bryson' (1902); 'The Daughter of A Magnate' (1903); 'The Close of the Day' (1904); 'The Strategy of Great Railroads' (1904); 'Whispering Smith' (1906); 'Robert Kimberly' (1911); 'The Mountain Divide' (1912); 'Merrilie Dawes' (1913); 'Nan of Music Mountain' (1916), and contributes short stories to magazines and economic articles to reviews.

SPEARMINT, a European labiate herb (*Mentha spicata*), which has become perfectly naturalized in America, and is often found in damp places. It is about two feet high, smooth, square-stemmed, and spreading by leafy stolons. It bears opposite, lanceolate, sharply serrate, smoothish leaves, and small, two-lipped, purplish flowers in slender verticillate spikes, which are both lateral and terminal, the latter being the longest. Spear-mint is cultivated for its very aromatic foliage, which yields a carminative oil, and was an old-time remedy for flatulence. It is now chiefly employed, with vinegar, as a fitting sauce for roast lamb, and sprigs of it are the crowning feature of the seductive mint-julep.

SPEARS, spērz, **John Randolph,** American author and journalist: b. Van Wert, Ohio, 21 April 1850. Among his many publications are 'The Gold Diggings of Cape Horn' (1895); 'The Port of Missing Ships' (1896); 'The History of Our Navy' (1897); 'The History of the American Slave Trade' (1900); 'Anthony Wayne' (1903); 'The History of the Mississippi Valley' (1903).

SPECIAL SESSIONS, Court of. See COURT.

SPECIE (spē'shē) **CIRCULAR,** a treasury circular drafted by Senator Benton and issued at President Jackson's orders 11 July 1836, which directed that nothing but gold and silver should be received in payment for the public lands. The next Congress passed a bill to rescind this specie circular, but President Jackson killed it by a veto. It was claimed by President Jackson's opponents that the circular contributed greatly to bring about the ruinous financial crisis of 1837.

SPECIE PAYMENTS, in finance, a payment in coin or any metallic money; a medium of exchange authorized by the government or State. In modern times specie is largely used by banks as security for paper money in circulation. In times of financial stringency the amount of coin on hand is inadequate to cover the volume of paper in circulation; hence arises a temporary condition called suspension of specie payment. When conditions change and finances improve a resumption of specie payments generally ensues.

SPECIE RESUMPTION. The resumption of specie payments after the close of the American Civil War was a subject of long and anxious discussion in Congress and in the press. In 1861 payment in specie was suspended by the government and by banks throughout the United States, and Congress authorized the issue of United States notes to meet the expenses of the conflict, and to be accepted as legal tender for all dues except customs. The receipt of specie for customs duties kept the treasury well supplied with gold and silver, and enabled the government to meet obligations payable in coin. After the war, and indeed from the closing scenes of the Confederacy, the premium on gold gradually fell until it was merely nominal, but the fact that the government's paper currency was not redeemable on presentation in coin kept that currency from being at par, and tended to unsettle business, and to provoke, or afford an excuse for serious financial crises. The question of resumption was most earnestly agitated after the panic of 1873, and on 14 Jan. 1875 an act was passed by Congress, ordering the resumption of specie payments to begin on 1 Jan. 1879. The approach of that date was attended by great apprehension in the United States and abroad that the national treasury would be unable to meet the overwhelming demand for specie that many expected to occur. The mints were run far beyond the usual hours coining money to meet possible requirements, and there was much surprise when the appointed date came, and very little currency was presented for redemption. The people were satisfied of the government's ability to pay, and gold at once fell to par. «Greenbacks,» as the national currency is called, became the equivalent of gold throughout the world, and have ever since maintained that position.

SPECIES, a group of individuals which agree in exhibiting certain distinctive hereditary characters of sufficient importance to render a particular name convenient. When we familiarly talk of the different «kinds» of plants and animals, we indicate in a rough way the biological ideal of species; and the recognition of raven, jackdaw and rook, as different kinds of crow, corresponds with the scientific distinction of these as four different species of the genus *Corvus*. (See GENUS). In many a case, however, where the distinctive hereditary characters are less conspicuous, the ordinary observer may see only one «kind» where the trained naturalist detects many «species.» Moreover, where a naturalist unfamiliar with the details of a particular class of animals might discern only half a dozen distinct species, the specialist might distinguish a score. In fact, the conception of species is entirely relative to convenience; where the «lumpers» think a score of special groups with special names quite sufficient, the «splitters» may think it necessary to distinguish a hundred. Except in cases where the limitations of group from group are very clear, as in the case of the four «kinds» of crow above mentioned, it requires a period of criticism before a satisfactory compromise between the «lumpers» and the «splitters» can be arrived at. And the reason for this is simply that in many cases one species is linked to another by intermediate varieties, and, it may be, also by hybrids.

Collections of definitions of «species» have often been made; and the curious will find a score in Quatrefages' posthumous work, 'Darwin et ses précurseurs Français.' Thus, Linnæus wrote: «Species tot numeramus quot diversæ formæ in principio sunt creatæ.» Buffon defined species as «a constant succession of individuals similar to, and capable of reproducing each other.» De Candolle said that a species was «an assemblage of all those individuals which resemble each other more than they do others, and which are able to reproduce their like, in such a manner that they may be supposed by analogy to have descended from a single being or a single pair.» Quatrefages' idea of species is summed up in his statement that it is «an assemblage of individuals more or less resembling one another, which are descended, or may be regarded as being descended, from a single pair by an uninterrupted succession of families.» Müller says species is a «living form, represented by individual beings, which reappears in the product of generation with certain invariable characters, and is constantly reproduced by the generative act of similar individuals.» These illustrations may suffice to impress the fact that the *invariable* nature of species had become firmly fixed on the minds of the older naturalists in former years.

A species, it may safely be concluded, represents no immutable, fixed or unvarying group, but a very variable one, differing widely in the extent of its variation in different cases. A species is a relative and subjective conception; the reality is in the component individuals. See EVOLUTION, HISTORY OF; EVOLUTION, THEORIES OF; EXTINCTION OF SPECIES; HYBRIDITY.

SPECIES, Extinction of. See EXTINCTION OF SPECIES.

SPECIFIC DUTIES. See DUTY.

SPECIFIC GRAVITY. The specific gravity of a body is the ratio of the mass of that body to the mass of an equal volume of some standard substance which is arbitrarily selected for purposes of reference. In the cases of solids and liquids it is customary to select water as the standard substance; and water is always understood, in connection with solids and liquids, unless the contrary is explicitly stated. Gases are also sometimes referred to water, but it is much commoner to compare the density of a gas with that of air or hydrogen. The specific gravity of a solid which is not affected by contact with water may be determined by weighing the solid twice — once while it is surrounded with air, and once while it is submerged in water. The difference between the two weights so obtained gives the weight of a mass of water whose volume is equal to that of the solid; and hence, in order to determine the specific gravity of the solid, it is only necessary to divide the weight as observed in air by the loss of weight when it is submerged in water. If the solid is soluble in water, or if it is affected by water in any other manner, its specific gravity must be determined by some indirect method. Many such methods are known. For example, we may replace the water by some other liquid, such as benzene, in which the solid is not soluble, and then perform the experiment precisely as described above. The result so obtained is the specific gravity of the substance with reference to the benzene (or whatever liquid is employed in its place); and in order to express the specific gravity of the body with reference to water we have merely to multiply its specific gravity with respect to benzene by the specific gravity of the benzene as compared with water.

The specific gravity of a liquid may be determined very accurately by means of the «specific gravity bottle.» This is a bottle made of thin glass (so as to be light), and provided with a ground-glass stopper. The weight of the bottle is determined (1) when it is empty, (2) when it is filled with water, and (3) when it is filled with the liquid whose specific gravity is desired. From these data we can easily determine the weight of the water in the bottle, and also that of the second liquid; and upon dividing the latter by the former we obtain the specific gravity sought. The specific gravity of a liquid may be obtained more expeditiously (though less accurately) by means of the simple instrument known as the hydrometer. This consists essentially of a glass bulb (usually cylindrical in shape), provided at its upper end with a graduated stem and weighted at its lower end with shot or mercury, so that it will float in an upright position when placed in a liquid sufficiently dense to permit it to float at all. It is evident that such an instrument will be buoyed up more by a dense liquid than by a lighter one; and when the stem at its upper end has once been graduated correctly we have only to place the hydrometer in the liquid whose specific gravity is desired, and observe the depth to which it sinks, as read from the graduated stem. In Fahrenheit's form of the instrument there is only one graduation mark on the stem; but a small pan is provided at the top of the hydrometer, and the observation consists in determining what weights must be placed upon this pan in order to cause the instrument to sink to the standard level indicated by the mark on the stem. Hydrometers are often graduated for special purposes, so that instead of indicating the specific gravity of the liquid in which they are placed, their readings give at once the percentage of alcohol (or of some other substance) that is present. Such instruments are called alcoholometers, salinometers, lactometers, etc., according to the special kind of liquid for whose investigation they are graduated.

As the density of water varies with the temperature, it is necessary (if we are to have a standard of density that is definite and accurate enough for scientific purposes) to specify the temperature of the water with which the comparison is made. In England the standard temperature of the water was formerly taken at 62° F.; but it is now the almost universal practice to make the comparison with water at its temperature of maximum density, or at about 39° F. In the vicinity of this temperature, the density of water varies very slowly with the temperature, and hence in comparing the density of a substance with that of water at or near 39° F., it is not essential to observe the temperature of the water with any high degree of precision. It was, indeed, this convenient and practical fact which led to the adoption of 39° F., as the standard temperature of the water.

Following are the specific gravities of various substances, as compared with water at 39° F.; the temperature of the substances being also supposed to be 39° F., except when otherwise specified. It is to be understood that the specific gravity of a solid varies to some extent with the physical condition of the solid. The foregoing values, however, are sufficiently accurate for general purposes; and more precise information is given in this encyclopedia, in many cases, in the articles upon the several substances named.

TABLE OF SPECIFIC GRAVITIES.

Aluminum	2.68
Antimony, cast	6.71
Bismuth, cast	9.82
Brass	8.5
Copper, drawn	8.88
Diamond	3.52
Gold, stamped	19.36
Gold, cast	19.26
Graphite	2.3
Melting ice	0.92
Iron, wrought	7.79
Iron, cast	7.0 to 7.7
Lead, cast	11.35
Mercury	13.596
Phosphorus	1.83
Platinum	21.7
Potassium	0.86
Pyrites, iron	5.0
Quartz	2.65
Silver, cast	10.47
Sodium	0.97
Steel	7.82
Sulphur, native	2.03
Tin, cast	7.29
Zinc, cast	7.1
Sulphuric acid	1.85
Carbon disulphide	1.29
Nitric acid	1.56
Chloroform	1.48
Glycerine	1.26
Hydrochloric acid	1.24
Sea-water	1.025
Olive oil	0.91
Turpentine	0.87
Ether (at 70° F.)	0.72
Alcohol, absolute	0.79
Bromine (at 32° F.)	3.19

The term specific gravity is not now used as commonly as it formerly was, the density of the substance being spoken of instead; it being understood in such cases that it is the density of the substance relatively to water that is meant, and not its absolute density as expressed in units of mass per unit of volume. In the system of units employed in the United States and in England, this double use of the word density may sometimes lead to confusion. The metric system is now, however, very largely used in scientific work, and here the confusion cannot well occur; for in the metric system the unit of mass (the gramme) is the mass of a cubic centimeter of water at its temperature of maximum density; and hence, in this system, the "absolute density" of a substance, and its "density relatively to water," are one and the same thing.

In the case of gases the expression specific gravity is now almost never used; density having practically displaced it. The accurate determination of the density of a gas is very difficult, and calls for great experimental skill and the finest of apparatus. In the usual method of performing such a determination a pair of glass globes, as nearly identical as possible, are suspended from the respective arms of a delicate balance and weights are added at one end or the other until perfect equilibrium is attained. One of the globes is then thoroughly exhausted by means of an air-pump, while the other is filled with the gas under examination. The equilibrium of the balance will be destroyed by this process, and if we restore it by adding weights to the arm carrying the exhausted sphere we shall thereby ascertain the weight of the gas in the other sphere. By repeating the experiment with gases of different kinds the weights of equal volumes of these different gases will be ascertained; and if the various weights so obtained are all divided by the weight as obtained for hydrogen (for example), the quotients will be the densities of the various gases, with respect to hydrogen. The relative densities of some of the more familiar gases are given in the following table, it being understood that the pressure in every case is one atmosphere, and the temperature 32° F. The relative densities of the gases here given do not change much for considerable variations of temperature and pressure; but this constancy is only approximate, not absolute; and hence, in the interest of accuracy, it is desirable to state (as follows) the precise conditions under which the table is exact.

According to the experiments of Regnault, a cubic centimeter of hydrogen, at the freezing point of water and under a pressure of 760 millimeters of mercury at Paris, weighs 0.00008956 grams; and from this fundamental constant it is easy to find the weight, under

DENSITIES OF GASES, RELATIVELY, TO HYDROGEN.

Hydrogen	1.000
Methane (" marsh gas ")	8.118
Ammonia gas (NH_3)	8.592
Carbon monoxide	13.78
Nitrogen	14.02
Ethylene (olefiant gas)	14.18
Air, dry	14.44
Oxygen	15.882
Carbon dioxide	22.08
Cyanogen	26.01
Sulphur dioxide	30.54
Chlorine	34.98

these same conditions, of a cubic centimeter of any of the gases whose densities with respect to hydrogen are given in the foregoing table.

Consult any standard work on general physics.

ALLAN D. RISTEEN, PH.D.

SPECIFIC HEAT. Maxwell defines this expression as follows: «The specific heat of a body is the ratio of the quantity of heat required to raise (the temperature of) that body one degree, to the quantity required to raise (the temperature of) an equal weight of water one degree.» For most engineering purposes, and for rough calculations of all kinds, this definition is sufficiently accurate. It assumes, however, that the quantity of heat required to raise the temperature of one pound of water by one degree is the same in all parts of the thermometric scale; and while this is approximately true, it cannot be admitted when we have to deal with heat-measurements of a high order of precision. We must then define the specific heat of a body as the number of units of heat that must be added to a unit mass of the body, in order to raise the temperature of the body by one degree; a unit of heat being simultaneously defined as the quantity of heat that is required in order to raise the temperature of a unit mass of water by one degree at some particular part of the thermometric scale. Various suggestions have been made as to the particular temperature that the water should have, in the definition of the unit of heat; and different experimenters have used different units, to the great confusion of the subject of heat-measurement in general. There is now a marked tendency toward the general adoption of a temperature of about 15° C. (59° F.); so that a unit of heat would be defined (in the metric system) as the quantity of heat that is required to raise the temperature of one gram of water from 14.5° C. to 15.5° C.; and in the familiar English and American system the unit would be similarly defined as the quantity of heat required to raise the temperature of a pound of water from 58.5° F. to 59.5° F. Adopting this definition of the unit of heat, we may speak of the specific heat of water itself; the specific heat of that fluid at t° C. being the quantity of heat required to raise the temperature of a certain mass of water by one degree at t° C., divided by the quantity of heat required to raise the temperature of an equal mass of it by one degree at the temperature 15° C. It is easily seen that it is of the highest importance to the physicist to know precisely how the specific heat of water (as thus defined) varies with the temperature t°; and it might not unreasonably be assumed that this fundamental matter would early have received a satisfactory amount of attention. Such was not the fact, however. Regnault indeed made an elaborate study of the subject, and published his results in the tenth memoir of his first series (1847). His conclusions were accepted for many years, but it is now known that they are incorrect, the data that he gives being even inconsistent among themselves. The general acceptance of Regnault's work on the specific heat of water has vitiated many otherwise important researches on the subject of heat; but we are now in possession of data that appear to be very much superior, and the confusion that has prevailed in the past is likely to be avoided in the future. (With reference to Regnault's work on water, see a letter by J. Macfarlane Gray in *Engineering* for 9 Jan. 1885, p. 42; also a more extended discussion in the same journal for 12 July 1889, p. 57; also E. H. Griffiths, *Philosophical Magazine,* November 1895).

Rowland, in connection with his famous work on the mechanical equivalent of heat (1879), carefully investigated the specific heat of water over a range of temperature extending from 0° C. to about 40° C., and he first showed that in this interval the specific heat of water decreases with rising temperature, attaining a minimum value somewhere about the temperature 30° C. (Rowland, 'Physical Papers,' p. 387). Other experimenters have since corroborated his results; but it was not until 1902 that a complete series of apparently satisfactory measurements of the specific heat of water from the freezing-point (q.v.) to the boiling-point (q.v.) were published. These are due to H. T. Barnes, of McGill University, Montreal. Mr. Barnes assumes 16° C. as the temperature at which the specific heat is unity (that is, he takes, as his unit of heat, the quantity of heat required to raise the temperature of a gram of water by 1° C., at 16° C.). His results ('Philosophical Transactions,' A, Vol. 199, p. 149) are as follows:

SPECIFIC HEAT OF WATER AT VARIOUS TEMPERATURES, IN TERMS OF A THERMAL UNIT AT 16° C. (BARNES).

Temperature	Specific heat	Temperature	Specific heat
5° C.	1.0053	55° C.	0.9985
10	1.0023	60	0.9991
15	1.0003	65	0.9997
20	0.9990	70	1.0004
25	0.9981	75	1.0010
30	0.9976	80	1.0017
35	0.9974	85	1.0024
40	0.9974	90	1.0030
45	0.9976	95	1.0037
50	0.9980		

The variation, as will be seen by the table, is quite small, and for many purposes the specific heat of water may be taken as unity at all temperatures. This will be assumed to be the case in the illustrations and explanations which follow; for the corrections which must be made in order to take the actual variation into account are tedious, and their accurate comprehension and application imply a certain knowledge of practical physics which the reader cannot be assumed to possess.

The specific heat of a body which is not affected by contact with water may be determined by heating the body to a known temperature, and then immersing it quickly in a definite mass of water whose initial temperature is also known. If we denote the mass of the water by W and that of the body under investigation by M, and if T_1 is the initial temperature of the water, and T_2 that of the body, and if S is the specific heat of the body and T is the final temperature that the body and the water have in common, we may calculate the specific heat, S, as follows: The temperature of the water has been raised from T_1 to T, and the mass of the water is W pounds, or grams, as the case may be. Then it follows that the number of units of heat that have been absorbed by the water is $W(T-T_1)$. Similarly, the body has cooled from T_2 to T, and its mass is M. Hence if the body had a specific heat precisely equal to that of water, we should know that it had given up $M(T_2-T)$ units of heat. Its actual specific heat, however, is S; and hence it follows, by the definition of specific heat, that the actual quantity of heat given out by the body is $SM(T_2-T)$ units. As we shall suppose that the radiation and conduction of heat between the apparatus and outside objects is negligible, it follows that the quantity of heat given out by the body is equal to the quantity absorbed by the water; that is, we must have the equation

$$W(T-T_1)=SM(T_2-T)$$

And from this we easily find

$$S=\frac{W(T-T_1)}{M(T_2-T)}.$$

In the actual conduct of an experiment of this kind there are many difficulties to overcome, and many corrections to be estimated and applied. There is always more or less communication of heat between the apparatus and outside objects, and the heat that is given out by the cooling body warms not only the water, but also the containing vessel, the thermometers and the stirring apparatus.

In determining the specific heat of a body advantage is often taken of the known fact that the quantity of heat required to melt one pound of ice at 32° F. is approximately the same as the quantity of heat required to raise the temperature of one pound of water by 140° F. In the application of this fact to the determination of specific heats the body under investigation is surrounded by ice, and the number of units of heat that are given off is determined by observing the quantity of ice that is melted, and multiplying that quantity (as expressed in pounds) by 140. Bunsen devised a very delicate apparatus for the execution of this sort of measurement. In his instrument the body to be studied is placed in a cup-shaped depression in a glass vessel that is filled with ice and water, and which is entirely sealed, save for a graduated capillary tube, one end of which enters the mixture of ice and water, while the other end projects into the air. The quantity of ice that is melted by the heat given off from the body is not directly observed, but is inferred from the change in volume of the ice-and-water mixture, as indicated by the motion of an index drop of mercury in the capillary tube; it being known that ice upon melting contracts by about one-twelfth of its own volume.

The specific heat of a gas is defined in precisely the same way as the specific heat of any other body; but in the case of gases it is necessary to specify the way in which the change of temperature of the gas takes place. Thus we may heat a gas while we maintain its pressure constant (permitting the volume to increase as much as it will), or we may heat it while its volume is kept constant (the pressure meanwhile increasing). The specific heats obtained under these two different conditions are quite different in numerical value, and they are distinguished respectively, as the «specific heat at constant pressure» and the «specific heat at constant volume.» The specific heat of a gas at constant pressure may be determined with considerable accuracy by causing a stream of the gas to flow through a calorimeter, so that it experiences a definite fall in temperature in its transit. The quantity of heat given up by the gas can be made to be very considerable (and hence easily measurable) by continuing the flow for a sufficient time; and to determine the specific heat at constant pressure, we then have merely to divide the total quantity of heat given out by the gas by the total mass of the gas that has been passed through the calorimeter, and again by the fall in temperature that the gas has experienced. The specific heat at constant volume is more difficult to obtain, and it has usually been determined by an indirect method, rather than by direct measurement. It can be determined directly, however, and apparently with considerable precision, by means of the Joly steam calorimeter.

Following are the specific heats of a number of substances; though it must be remembered that many of them are more or less uncertain, not only because they vary (in the case of solids) from one specimen to another, and from one temperature to another in all substances, but also because in their determination the thermometric and calorimetric work has unfortunately not always been beyond reproach.

TABLE OF SPECIFIC HEATS.

Aluminum	0.2122
Antimony	0.0486
Boron	0.252
Bromine (liquid)	0.1071
Carbon (diamond)	0.113
Carbon (charcoal)	0.194
Copper	0.0933
Gold	0.0316
Iron	0.112
Lead	0.0315
Magnesium	0.245
Mercury	0.0335
Nickel	0.109
Phosphorus	0.170
Platinum	0.0323
Silver	0.0559
Sulphur (freshly melted)	0.184
Tin (cast)	0.0559
Zinc	0.0935
Ice (at 0° F.)	0.504
Alcohol	0.65
Chloroform	0.235
Ether	0.54
Carbon disulphide	0.24
Air	0.2375
Oxygen	0.2175
Nitrogen	0.2438
Hydrogen	3.4090
Carbon dioxide	0.2163
Ammonia gas (NH_3)	0.508
Methane	0.593

In the foregoing table the results given for gases are the specific heats at constant pressure.

Consult Ganot, ‘Elementary Treatise on Physics,’ and Preston, ‘Theory of Heat.’

ALLAN D. RISTEEN, Ph.D.

SPECIFIC PERFORMANCE, in equity, a proceeding to compel the performance of a specific agreement, as the sale of land, when damages would not be an adequate remedy. It is within the discretion of the courts to grant or deny this form of relief, and in their decisions they are guided largely by precedent. It is more commonly decreed in cases of contracts to convey or lease land. Usually it is refused in cases of contracts to convey a chattel unless it is unique and cannot be secured elsewhere. It will not usually be decreed when there is an adequate remedy at law, when it is not reasonably possible, when the complainant has done something inequitable, or when the court cannot enforce or superintend the execution of its decision. Usually specific performance will not be granted in cases of personal services, as those of actors, painters; singers, etc., even if the damages recoverable at law are exceedingly inadequate.

SPECIFICATION, a detailed mention of particulars: (1) *In patent law,* the applicant's statement describing the method of construction and use of the device presented for patent. The description must be sufficiently clear to enable any person with requisite skill to make the article in question; and in United States law the process as described in the specification becomes a part of the patent, any necessary detail omitted being cause for invalidation of the patentee's rights. (2) *In architects', builders' or mechanics' contracts,* the description attached to the plans detailing the materials to be used, method of construction to be followed, the time permitted for the completion of the work and all other items of information which cannot be set forth in the drawings.

SPECTACLED BEAR, the bear of the South American Andes. See BEAR.

SPECTACLES, magnifying glasses made as a pair to be fitted over the eyes to aid the vision, supposed to have been invented by Roger Bacon in the 13th century, and used to magnify an object or correct some defect in the organs of vision. Spectacles consist generally of two oval or circular lenses mounted in a light metal frame which is made up of the «bows,» «bridge,» and «sides.» The lenses may be bi-concave, bi-convex, concavo-convex, etc., though lenses forming segments of a cylinder are used in some cases of astigmatism. In long-sighted persons the defect of the eye is counteracted by convex lenses, in short-sighted persons by concave lenses. When made without bows to hold on the ears or hair, and with a spring in the bridge, they are specifically termed eye-glasses, or pince-nez.

Divided or pantascopic spectacles have each lens composed of two semi-circles of different foci neatly united one above the other; one half for looking at distant objects, and the other for examining things near the eye. Another kind, called periscopic spectacles, has been contrived in order to allow considerable latitude of motion to the eyes without fatigue. In such case the concave side of a diverging meniscus lens is placed toward the eye. A modern form is made of plain glass with large rims, as of imitation tortoise shell, for protection of the eyes against sand, etc., as encountered in driving an automobile. Colored lenses of flat glass are employed in spectacles to relieve the eyes of a glare of light. Wings or «blinders» are sometimes added to keep out the dust. Where two lenses are supplied for each eye they are termed compound spectacles or compound lens spectacles. Ordinary standard spectacle lenses are numbered according to the inches of focal distance, a No. 12 involving holding a paper at a distance of 12 inches from the eye to get the correct focus and read easily. Astigmatism (q.v.) is so common that spectacles are frequently made to a prescription, each glass being ground to a curve to correct the inaccuracy of the eye. Consult Crookes, 'Preparation of Eye-Preserving Glass for Spectacles' (1914). See LENS; EYE; VISION.

SPECTATOR, The. Tuesday, 12 April 1709, deserves to be remembered as an important date in the history of English literature. For on that day Richard Steele issued the first number of *The Tatler.* This modest half sheet, issued thrice a week, was in reality the beginning of English periodical literature. Defoe had founded his *Review* two years before; but that was a little sheaf of political news and opinions with no charm of literary quality. It was the merit of Steele to perceive the opportunity for a new form of journal which should picture, in entertaining fashion and in a temper of kindly satire, the manners and conduct of contemporary society. He put at the head of his first number a couplet from Juvenal:

> "Whatever men do, or say, or think, or dream
> Our motley paper seizes for its theme."

Addison, it seems, had not been informed of Steele's project, and did not recognize the hand of his friend until the sixth number. He is supposed to have written the eighteenth paper, but did not join Steele as a regular contributor until near the close of the year 1709. In the next two years his aid became indispensable. As Steele himself said, «I fared like a distressed prince who called in a powerful neighbor to his aid, and when I had called him in I could not subsist without him.» On 2 Jan. 1711, *The Tatler* was brought suddenly to an end, but after an interval of two months was followed by that more famous paper, *The Spectator. The Spectator* is usually spoken of as Addison's; but in fact it was under the joint conduct of Addison and Steele, and the contributions of the two men were about equal in number.

Yet it is not without good reason that we speak of Addison's *Spectator.* Addison's humor, if less buoyant and convivial than Steele's, was more subtle, delicate and widely observant. Steele was the typical man about town, who threw himself heartily into the life of the hour; Addison was rather, as he styled himself, a spectator who sat in his arm-chair at Buttons and watched the varied play of life about him with quiet, superior satisfaction. Mr. Spectator is always courteous, refined, urbane. You feel in his page the charm of manners and the grace of good society; and if in many of his papers there is a flavor of pretty malice, it is directed against the follies and foibles, the petty meannesses that often hide under outward good breeding. His best papers are doubtless those devoted to this kindly social satire.

Yet it is possible that Addison himself estimated more highly the critical and the ethical essays which usually appeared, the one kind on Fridays and the other on Saturdays. Some of the critical papers, especially the famous series on Milton's Paradise Lost, have been greatly admired and frequently reprinted. But the reader of to-day will probably not find them of absorbing interest. Their criticism is purely formal and academic; Addison is trying to prove by Aristotle's rules, that Milton was a great poet. Of all such criticism it may be said that, if the reader knows his Milton, it is needless; if he does not, it is useless. The ethical and religious papers though perhaps less often mentioned, are some of them rather more entertaining. Addison was the son of a dean and always something of a preacher himself. «He's a parson in a tie-wig,» said Mandeville. And when the parson in a tie-wig preaches to us from *The Spectator's* chair of a Saturday, the sermon may sometimes be a little prosy, but it is always wholesome and genuine. It is a calm and winning religion Mr. Addison has to recommend, and he exemplified it himself. It is quite possibly true, as some one has said, that *The Tatler* and *The Spectator* did more for English society than all the sermons preached in the Queen Anne time; for they brought religion and morality into fashion.

But most of the humor and the wisdom of *The Spectator* might have perished had it not been for the perfection of the style in which they were conveyed. Steele wrote as he talked, in rapid, careless fashion; he would not stay for careful elaboration or tedious correction. Addison, on the contrary, was careful, even finical in all matters of expression; but his effort issued in a style simple, suave, urbane. He succeeded in combining idiomatic ease with perfect finish as no other writer of his time could do, and very few have done since. Everybody remembers the admiring dictum of Johnson: «Whoever would attain in English style, familiar but not coarse, elegant but not ostentatious, must give his days and nights to the study of Addison.» The critic to-day may find his thought lacking in depth, and his manner lacking in energy; but few writers have known better how to marry their thought and feeling with perfect phrase.

The immediate success of *The Tatler* and *The Spectator* is significant of an important change in English society. For some 50 years there had been growing up in England a great middle class, shrewd, intelligent and rapidly gaining wealth. They owned a great part of the national debt that England had been rapidly piling up; they were actively interested in politics; they formed the majority of the Whig party that was to rule for nearly a hundred years. It was this class that furnished for the first time in England a large reading public. By the Queen Anne time they were crowded into London, where they were readily accessible to the pamphleteer and journalist. Eighty thousand copies of Defoe's 'True Born Englishman' were sold on the streets of London, and Swift's 'Conduct of the Allies' ran through four editions in one week. It was Steele and Addison who first hit upon the new literary form adapted to the wants of such a class of readers. They were the creators of English popular literature. It was Addison, especially, who saw that such writing, however familiar or even trivial its themes, is susceptible of that exquisite finish that ensures its permanence. *The Spectator* had scores of imitators in the course of the century, the most famous of them being *The Rambler* and *The Idler* of Samuel Johnson; but none of them equaled their model in variety of theme or charm of treatment. Consult Johnson, Samuel, 'Lives of the Poets'; Courthope, 'English Men of Letters'; Stephen, Leslie, 'Dictionary National Biography'; Thackery, 'English Humorists'; 'Cambridge History of English Literature' (Vol. IX, ch. 2).

CALEB T. WINCHESTER,
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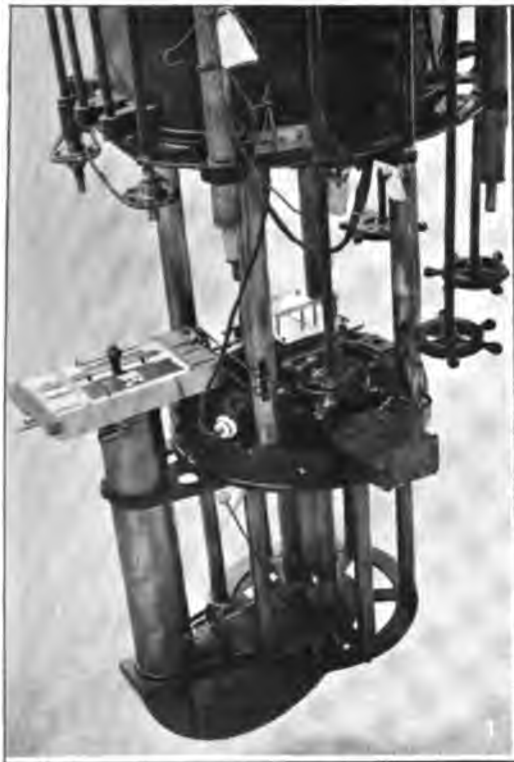
SPECTROMETER, an instrument having a prism in the centre and telescopes for measuring the angular deviation caused by passing of light through the prism. This determines the degree of refraction of the glass or other substance of which the prism is made. A diffraction grating of polished metal or glass closely ruled in parallel lines may be substituted for the prism in some forms of spectroscope. In the most familiar type, a three-sided prism is mounted on a central table and a short tube or telescope reflects the light from an outer mirror to a collimating lens to make a beam in which the light rays all are parallel and directed on the prism. Another tube or telescope is positioned to observe another face of the prism, and this observing telescope has cross wires for noting lines accurately. There being a graduated circle in the central table, it becomes a matter of measurement to observe the difference, if any, at which the parallel rays enter and leave the prism. The angle of the faces of the prism has to be considered in making the calculation. With a diffraction-grating the data can be obtained to calculate the wave-length of the light-ray that passes.

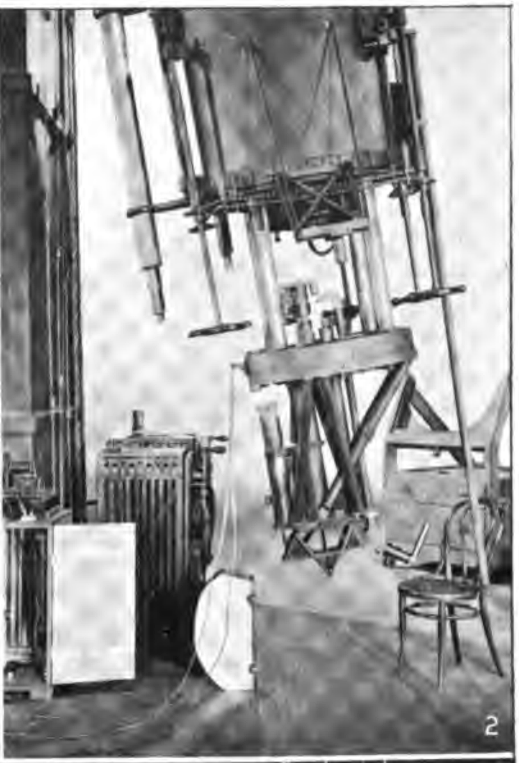
SPECTROSCOPE, the instrument employed in spectrum analysis. See SPECTROSCOPY.

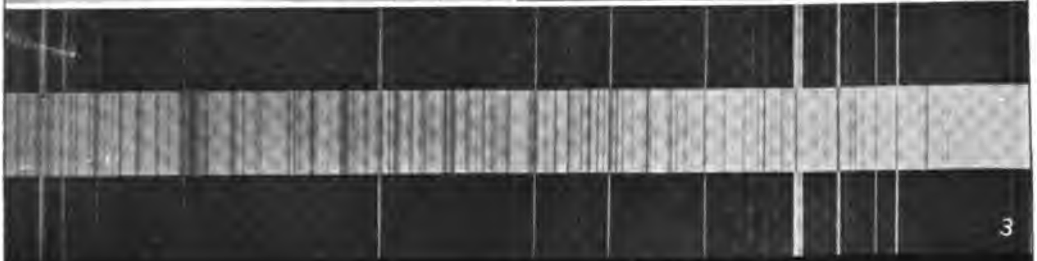
SPECTROSCOPY. If one observes a Bunsen flame through an ordinary glass prism held close to the eye he will see a succession of colored images of the flame. This series of colored images is called the spectrum of the flame. An instrument, such as the prism, which will separate the various radiations emitted by any source of light, is called a spectroscope. Spectroscopy is, therefore, defined as that science which has for its object the determination and description of the various radiations which different bodies emit, reflect and absorb. The subject is here treated under seven headings as follows: (1) Preliminary, concerning the Nature of Light; (2) Sources of Radiation; (3) Separation of Radiations; (4) Methods of Recording Radiations; (5) Comparison and Interpretation of Radiations; (6) Summary of Principles; (7) Bibliography.

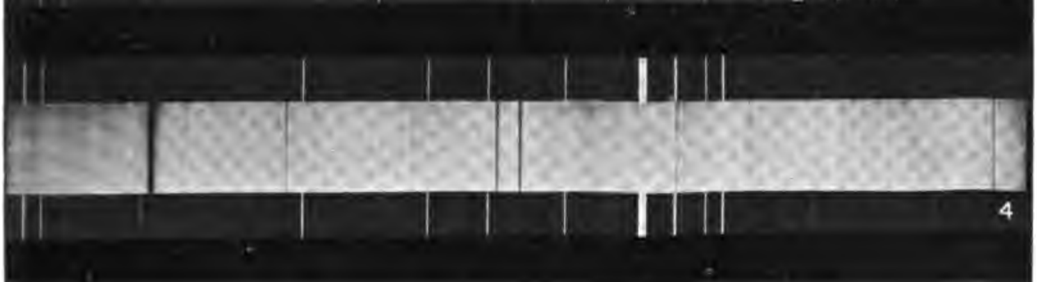
1. **Nature of Light.**— Present views concerning that form of energy which we call light are based almost wholly upon experimental evidence furnished by Huygens, Newton, Young and Fresnel. Since light is the subject matter of spectroscopy, it is essential, at the outset, that we should understand the modern theory of light as perfected by these four men. Huygens,

SPECTROSCOPY









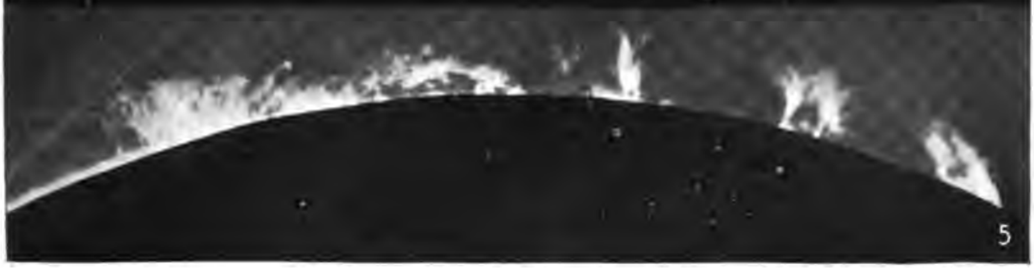


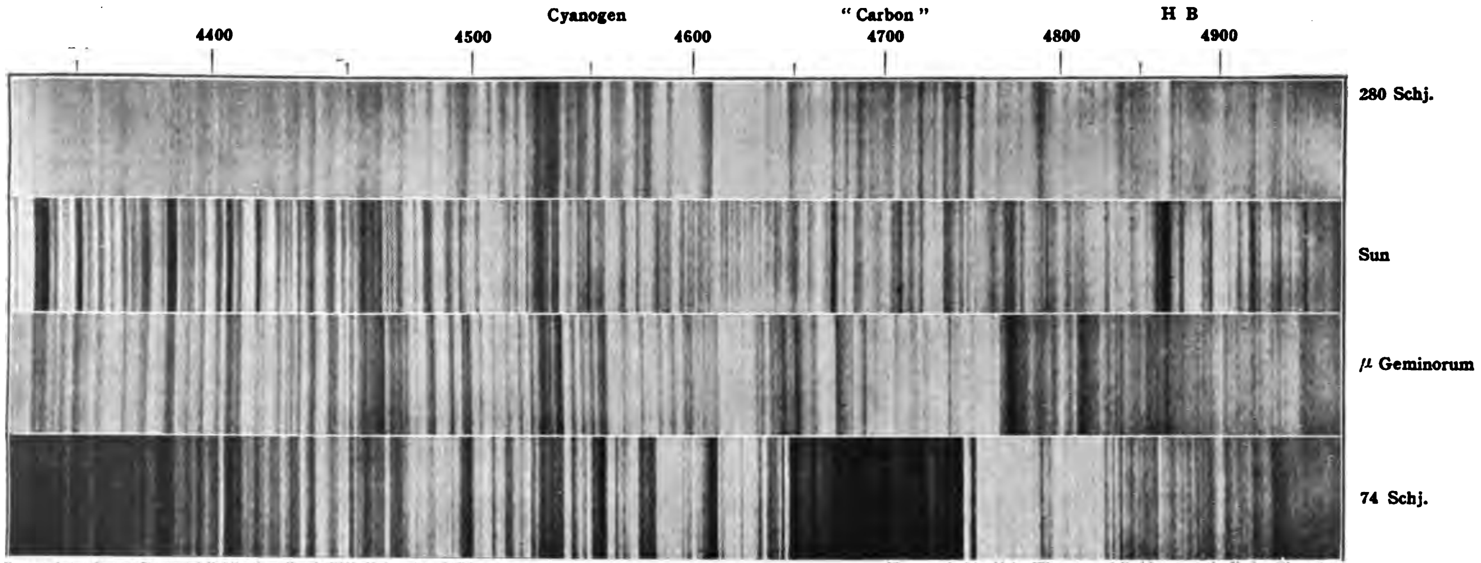
Fig. 1 The Rumford spectroheliograph attached to the 40-inch telescope

Fig. 2 The Bruce spectrograph attached to the 40-inch telescope of the Yerkes Observatory, showing accessories, induction coil for producing comparison spectrum, metallic cases for controlling temperature and the three large prisms

Fig. 3 Spectrum of Alpha Persei with comparison spectrum of titanium (bright lines above and below)

Fig. 4 Spectrum of Beta Orionis (Rigel) with comparison spectrum of titanium, in an early stage of development, showing lines of few elements, hydrogen, helium and magnesium

Fig. 5 A group of solar prominences about 30,000 miles high, eruptions of calcium vapor containing other elements, photographed through the calcium line H



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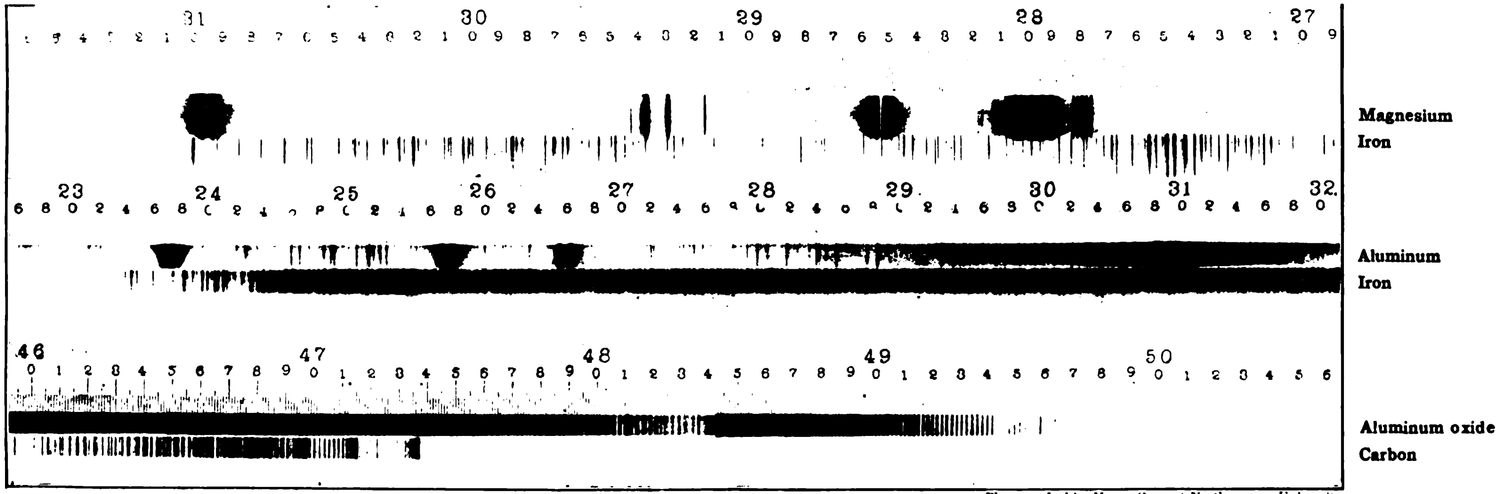
Photographed by Hale, Ellerman and Parkhurst, at the Yerkes Observatory



Photographed by Henry Crew at Northwestern University

1 Stellar Spectra

2 Spectra of Metals

by assuming that light consists of a wave-motion in the ether, showed that on simple dynamical principles, reflection, refraction and the finite velocity of light might be easily explained. He first interpreted for us the physical constant known as the «refractive index,» suggesting that for any medium it is merely the ratio of the speed of light in air to the speed of light in that medium. To Newton we owe two capital discoveries concerning the nature of light. In 1669 he demonstrated experimentally that white light contains all the colors of the rainbow, that the simple prismatic colors obtained by analyzing white light cannot be farther separated into other colors by passing them through prisms, and that color, in general, is merely white light from which has been removed some of its colored constituents. Besides this, Newton established the fact that these luminous disturbances (which he thought of as moods of easy and of difficult transmission, but which we now call light-waves), are not irregular pulses, as Huygens imagined, but are periodic in character. This inference is drawn from the phenomenon known as «Newton's Rings.» We come next to the work of Thomas Young (1773–1829) who first demonstrated the fact that, under proper conditions, two rays of light, that is two trains of light-waves, may interfere in such a manner as to produce darkness. Young's explanation of diffraction, however, proved to be utterly insufficient, and for the phenomenon of polarization he could offer no explanation whatever, for the reason that he conceived light-waves to be longitudinal and not transverse vibrations. To summarize Young's work most briefly would be to say that he introduced into optics the principle of interference — or of «non-interference,» as suggested by Michelson, since the principle consists merely in the fact that of two light rays meeting at a point each produces its own effect independently of the other. Fresnel (1788–1827), in a certain sense, perfected the wave-theory of light by combining the principle of Huygens with the principle of interference and by introducing the idea that light-waves, unlike sound-waves, are transverse disturbances. Evidence for this view lay in the fact that light can be polarized. We may now summarize the labors of these four men by saying that experiment seems to indicate that light consists in a transverse wave-motion in a medium which pervades all known space and which we call the ether. In space devoid of ordinary matter light of any color travels with a speed of approximately 186,330 miles per second, while in all ordinary matter light travels with less speed, the amount of diminution becoming greater and greater as we pass from the red to the violet.

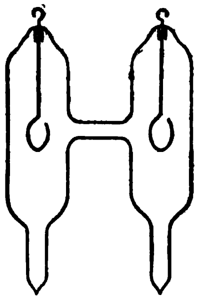


Fig. 1.— An "end on" tube. Shows one form of tube recently employed by Michelson, in which the discharge is viewed from the end, rather than the side of the tube, and which is known, therefore, as an "end on" tube.

Bearing in mind this conception of a train of light-waves, we proceed to consider the general method of spectroscopy. The examination of a body by means of the spectroscope includes, in general, four steps. These are:

A. The Production of the Radiations.
B. The Separation of the Radiations.
C. The Recording of the Radiations.
D. The Comparison and Interpretation of the Radiations.

We shall in the following four sections consider these four steps.

2. Sources of Radiation.— In practice the spectroscopist is limited to two artificial sources, namely, flames and electric currents. Besides these are many natural sources such as lightning, the aurora borealis, meteors, stars, glowworms, etc.; but the nature and occurrence of these natural phenomena are so far beyond our control that they do not here call for discussion. Adopting the following classification, we now proceed to a description of some particular artificial sources.

- SOURCES..
  - Natural...
    - Lightning,
    - Stars, including the sun,
    - Comets,
    - Auroræ,
    - Meteors,
    - Glowworms,
  - Artificial....
    - Flames....
      - Candle,
      - Alcohol,
      - Bunsen,
      - Oxy-hydrogen.
    - Electric currents.
      - Arc,
      - Brush discharge,
      - Spark.

Candle and Alcohol Flames.— These have mainly a historical interest, as being the first sources in which line spectra were observed. The temperature of the alcohol flame is only roughly known, but is probably not far from 1,300° C. Substances are easily introduced into the flame and the flame itself is fairly colorless. These two qualities combined to make it very useful in the early history of the science.

Bunsen Flame.— The flame which Bunsen devised in 1856 has three marked advantages as a spectroscopic source, namely, it is simple in construction and operation; its outer mantle is almost totally devoid of any characteristic spectrum of its own; and it possesses a high temperature. Many measurements of the temperature of this flame have been made, but there is good reason for believing that nearly all of these are under-estimates. The most reliable measurement is probably that of Weggener, at Berlin, who obtained 1,788° C. for the outer mantle. The temperature of the violet mantle is probably about 100° or 200° less; while the temperature of the inner dark cone ranges from 250° to 500° C. The substance whose spectrum is desired may be introduced into the flame in a great variety of ways. Bunsen used a bead of the material on a platinum wire; sometimes a piece of asbestos is convenient; Gouy uses the spray from an atomizer; Eder and Valenta have employed a platinum wire-gauze wheel to transport the solution from a dish to the flame.

Oxyhydrogen Flame.— This flame is also nearly colorless, has an exceedingly high temperature and gives spectra approximating those obtained in the electric arc. It has been used with great skill by W. N. Hartley.

Electric Arc.— This source has been in common use since the invention of the Gramme dynamo, 1876. The arc is generally used in one of two ways, either by drilling holes in the carbon rods and filling these holes with the material whose spectrum is desired, or by making the electrodes directly and entirely out of the substance which is being studied. This latter method is, of course, practicable only in the case of materials which conduct electricity. The temperature of the carbon arc is not accurately known, but probably lies between 3,500° and 3,900° C. As a spectroscopic source it is admirable in nearly every respect except that in those regions of the spectrum which are most easily studied carbon has a strong spectrum of its own which is always superposed upon that of the substance under investigation. In the case of metals, the easiest method of avoiding this difficulty is to use a rapidly rotating metal disc for one electrode and a metal rod for the other. The incandescent metal vapor thus obtained yields the purest spectra known.

Electric Spark.— Of all sources of radiation that which is most generally convenient and most widely used is perhaps the electric spark, obtained by use of an ordinary induction coil. Spark discharges may also be obtained from an electrostatic machine, such as the Wimshurst, from a Tesla coil, or even from a high voltage storage battery. In general the electric spark produces two spectra, namely, the spectrum of the electrodes and the spectrum of the air or other gas between the two electrodes. But, as was discovered by Plücker in 1858, the spectrum of the electrodes may be avoided by enclosing them in a partial vacuum. Under these conditions one gets only the spectrum of the surrounding gas; so that now the almost universal method of studying the spectra of gases is to seal platinum electrodes into a glass tube and then fill the tube under low pressure with the gas to be studied.

The converse problem of getting the spectrum of the electrodes, without that of the surrounding gas, has been solved by Demarcay, Schuster and Hemsalech, who have proved that practically all the «air lines» of a spectrum may be eliminated by placing in the discharge circuit a proper amount of inductance. In this manner the discharge is prolonged and is made to resemble that of the arc.

The electrodes are connected in series with an inductance I, and in parallel with a capacity C. Concerning the temperature of the spark very little is known. It has been generally assumed to be very much higher than that of the electric arc: but there is no direct evidence for this view and there is much indirect evidence against it.

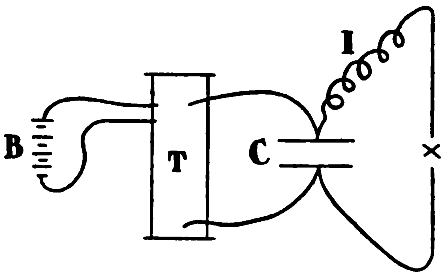


FIG. 2.— Circuit for spark discharge. Illustrates a typical discharge circuit. T is an induction coil or high voltage transformer. The primary circuit is operated by a battery, B, or some source of alternating current.

3. Separation of Radiations.— Let us suppose that we now have before us one of the above-mentioned sources whose spectrum it is desired to examine. The next step will be to separate the rays of various wave-lengths so that we may examine them independently. The reader may here assume that each different substance introduced into the flame or arc gives a different spectrum, peculiar to itself; for this is the experimental basis of spectrum analysis. This analysis is usually accomplished either by passing the light through a prism or by allowing it to fall upon a diffraction grating.

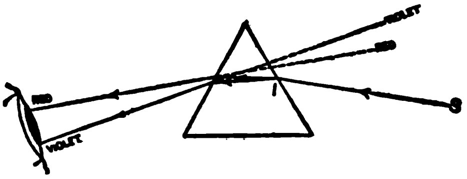


FIG. 3.— Prism used for examining a point- or line-source. [This figure is taken from Crew's 'Elements of Physics,' published by Macmillan Co., New York].

The Prism Spectroscope.— If the source of light be small and if it is necessary to make only a hasty visual examination, the most convenient plan is simply to view the source through a prism, placed immediately in front of the eye, as indicated in Fig. 3.

This is an especially useful method in observing the discharge in the capillary portion of a vacuum tube. The chief difficulty in the naked prism is that the source, however small, is generally still so large that the successive colored images formed by the prism will overlap each other, leaving the separation incomplete. To avoid this difficulty a small telescope — called a collimator — is placed between the prism and the source as shown in Fig. 4. In the principal focus of its objective is placed a narrow, straight slit with movable metal jaws. The source is now placed immediately back of this slit, or the image of the source is focused upon the slit by means of a lens, called the image lens.

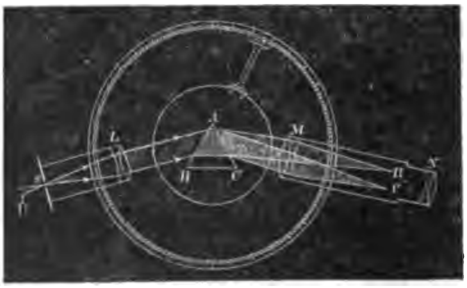


FIG. 4.— Diagram of spectroscope.

When the slit is properly placed and illuminated the collimator will emit from each point of the slit a beam of nearly parallel light whose cross-section is equal to the effective aperture of the objective. If now this emergent beam be examined through a prism and the naked eye as before, a series of colored images of the slit will be seen, each appearing to be at an infinite distance from the observer; and if the slit is narrow these images will be sharp and fine and easily separated. But they will not, in general, appear very bright because the aperture of the human eye is too small to admit more than a fraction of the emergent beam. Accordingly these colored images, each at an infinite distance, are viewed through a small astronomical telescope, called the view telescope. This serves to condense the entire beam which emerges from the prism and reduce it to another parallel beam just large enough to fill the aperture of the average human eye.

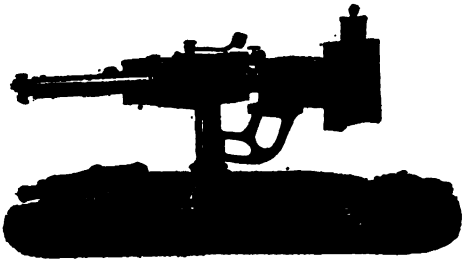


FIG. 5.— The spectrograph. [This figure is taken from the optical catalogue of Steinheil in Munich, Germany].

When it is desired to photograph a spectrum the view telescope is removed and is replaced by a camera with a photographic objective. Such an instrument is known as a spectrograph and an excellent modern form of it is illustrated in Fig. 5.

When the typical spectroscope, represented in Fig. 4, is provided with a graduated circle, and so arranged that the view telescope and the prism can rotate about the axis of the divided circle, the instrument is known as a spectrometer, and can be employed for the measurement of prism-angles and wave-lengths as well as for the examination of spectra. In this type of spectroscope it is nearly always necessary for the sake of good definition to place the prism in such a position that it will produce a minimum deviation in the incident pencil of rays. For it is proved in geometrical optics that a homocentric pencil will remain homocentric after passing through a prism only provided the prism is placed in its position of minimum deviation. If the prism be set in any other position the image of a point-source will not be a point, but a line.

Resolving Power of a Prism.— If one had a prism spectroscope which was practically perfect so far as all the optical parts are concerned, he would yet find that the ability of the prism to separate light-waves of different lengths was subject to still another limitation — a limitation which arises ultimately from the fact that light-waves have an appreciable length. This ability to separate radiations is known as "resolving power" and is measured by the ratio $\frac{\lambda}{\delta l}$ where $\delta\lambda$ is the difference of the wave-length and λ the mean wave-length of two spectral lines which can just be resolved by the dispersion piece in question.

Rayleigh has proved that a prism can just resolve two lines when the difference of their refractive indices $\sigma\mu$ is given by the following equation $\delta\mu = \frac{\lambda}{t_2 = t_1}$ where t_2 and t_1 are the thickness of glass traversed by the extreme rays on either side of a parallel beam passing through the prism.

If now $\delta\mu$ be expressed in terms of $\delta\lambda$ by means of a dispersion formula such as the following, due to Cauchy, we have

$$\mu = A + \frac{B}{\lambda^2}, \text{ and } \delta\mu = \frac{2B.\delta\lambda}{\lambda^3}$$

where A and B are constants depending upon the kind of glass employed in the prism.

From these it follows that the resolving power, R, for prism is

$$R: \quad \frac{\lambda}{\delta\lambda} = \frac{2B(t_2 - t_1)}{\lambda^3}.$$

This equation is fundamental in describing the spectroscopic value of a prism. It means that the resolving power varies directly as the width of the prism and inversely as the cube of the wave-length of the light examined. It tells us also just how thick a prism of any given glass must be, at its base, in order to separate two lines having a given difference of wave-length. The prism spectroscope was first effectively used by Fraunhofer (1817–28); but it was not until 1859 that Kirchhoff and Bunsen demonstrated the power of the instrument in chemical analysis, and in a study of the sun's physical condition.

The Grating Spectroscope.— So far as its auxiliary parts are concerned this piece of apparatus is very like the prism spectroscope: but as regards its essential feature, the dispersing piece, the two instruments are radically different. For the dispersion which is produced by a prism rests ultimately upon the fact that waves of longer length travel through glass at a higher speed than those of shorter length: while the dispersing effect of a grating is due to the fact that when waves of different lengths are forced to pass through a narrow opening, they are all spread out like a fan—diffracted—the longer waves being more spread out, however, than the shorter ones. If a gas flame, turned low, or an incandescent electric lamp be examined through a single narrow slit in a visiting card, a number of spectra will be seen on each side of a central bright image. These have been called, by Fraunhofer, "spectra of the first class." They are *not* used in spectroscopy. If, however, the same source of light be viewed through two or more fine parallel equidistant slits, placed close together, say less than one-sixty-fourth inch apart, another series of spectra will be observed. These are the combined effect of light passing through several openings; they are known as "spectra of the second class" and are practically the only ones in the grating spectroscope. These narrow equidistant parallel slits were first prepared by Fraunhofer (1821) who formed them by wrapping fine wire over the thread of two parallel screws, then soldering the wires to the screws and cutting away one entire side of the little cage thus formed. Such a device he called a grating. The modern grating is made by ruling straight lines with a diamond point on a flat plate of highly polished speculum metal. Good gratings have usually from 5,000 to 20,000 lines per inch. Here the light is reflected from the unruled surface between two successive furrows made by the diamond; and diffraction occurs exactly as if the light had passed through a narrow aperture of the same width. Such a device is called a reflection grating, and when placed where the prism stands in an ordinary prism spectroscope we have what is called a grating spectroscope.

When a beam of parallel rays emerges from the collimator and falls upon a grating placed with its rulings parallel to the slit of the collimator, part of the light is reflected according to the laws of ordinary reflection and forms, in the focal plane of the view-telescope, what is known as the central image. The remainder of the light, however, is spread out on either side of this central image, the blue light being deviated least and the red light (longest waves) being deviated most. Unlike the prism the grating yields several spectra distributed on each side of the central image.

If monochromatic light be viewed with such an instrument a series of bright lines — sharp maxima — each an image of the slit will be seen distributed on each side of the central image. The image nearest the central one is said to be of the «first order,» the next of the «second order,» etc. The properties of these images and of diffraction spectra, in general, are most briefly described by the following three equations, which follow directly from the wave theory of light

$$(a+b)\ (\sin i+\sin\theta)=m\lambda \quad . \ . \ . \quad \text{(Eq. A)}.$$

Here $a+b$ is the distance between corresponding points on two consecutive rulings —the so-called grating constant. The angle of incidence is denoted by i; the angle of diffraction by θ; the order of the spectrum by m and the wave-length by λ. This equation tells us exactly in what position, θ, we must set the view-telescope in order to observe a line of any given wave-length. Conversely it enables us to compute the wave-length when once we know the grating constant and the directions of the incident and diffracted rays.

$$I=I'\frac{\sin^2\dfrac{n\mu(a+b)}{2}}{\sin^2\dfrac{\mu(a+b)}{2}}\ , \quad . \ . \ . \ . \ . \ . \ . \quad \text{(Eq. B)}.$$

Here I is the intensity of the spectrum of a monchromatic source of wave-length λ in any given direction, produced by a grating which has n lines ruled upon it at a uniform distance, $a+b$, apart.

I' is the intensity which a single aperture would give in the same direction. The «given direction» is here defined by μ whose value is

$$\mu=\frac{2\pi}{\lambda}(\sin i+\sin\theta)$$

the symbols having the same meaning as in Eq. A.

It is important here to observe that Eq. A. merely defines the direction in which I of Eq. B reaches its principal maxima.

Lord Rayleigh has shown that the resolving power of a grating, R, is defined by the following simple expression:

$$R=\frac{\lambda}{\delta\lambda}=mN \quad . \qquad \text{(Eq. C)}$$

where N is the total number of rulings on the grating and m is the order of spectrum employed.

All of the best gratings of the world up to the present time have been ruled on Rowland's dividing engines at Johns Hopkins University. After Rowland's death, in 1901, his two ruling engines were not again used until Dr. J. A. Anderson took up this work in 1910. Most of these gratings are ruled with from 5,000 to 20,000 lines per inch; some of them have a ruled surface six inches in width, thus giving a resolving power of no less than 400,000 in the fourth-order spectrum. Such a resolving power is far in excess of anything attainable with prisms of practicable size. Dr. J. A. Anderson, and others, have recently devoted much attention to the problem of securing replicas, or reproductions, of the expensive Rowland gratings. The attempts thus far are full of promise, and if they become wholly successful it will be possible for the physicist and astronomer to secure this fundamentally important part of his apparatus at a cost which will be comparatively only a nominal one.

Concave Grating Spectroscope.— Recent advances in spectroscopy are due in a very large degree to the invention of the concave grating by Rowland in 1883. The distinguishing features of this instrument are that it requires no collimator and no view-telescope, and that it gives spectra which are normal throughout a large range. The ruling is upon a concave spherical mirror of speculum metal, the distance between the lines being equal when measured along a chord. It was with a spectograph of this type that Rowland and Higgs each prepared his superb atlas of the solar spectrum. The same kind of grating was also employed by Kayser and Runge in their profound study of the spectra of the elements.

The Echelon Spectroscope.— Measured by resolving power, the Echelon, devised by Michelson in 1898, is still a more effective instrument. This is essentially a grating with only a few rulings in which the form of the groove is under perfect control. This result is obtained by using a pile of plane parallel plates of equal thickness, the edge of each plate being slightly displaced over that of its preceding neighbor. The high resolving power is obtained by use of spectra of high orders, even as high as several thousand. The Echelon is especially adapted to the separation of the close components of a spectral line, as in the case of the Zeeman effect.

The Interferometer.— Another device for separating the close compound of what is ordinarily called a single spectral line is the interferometer, which is also largely due to Michelson. It is this invention which makes it possible to use the wave-length of the red cadmium ray as a standard of length instead of the international metre at Paris; for Michelson has shown that by the interferometer he can measure wave-lengths with an accuracy of one part in a million.

4. Methods of Recording Radiations.— Having separated the different lines in any spectrum, the next step, in general, is to record the intensity, position (wave-length) and physical character of each of these. Just how this is accomplished will depend partly upon the portion of the spectrum under examination and partly upon the purpose of the work. If the physical character of a line be the matter in question, a glance of the eye may be sufficient to determine it, or it may require an elaborate investigation by means of the interferometer, according to the detail and accuracy required. To record the position of a line within one Angstrom unit is ordinarily the work of a few minutes; but to measure a wave-length with an accuracy of 0.01 Angstrom unit demands skill of the highest order and plenty of time. In general, however, it may be said that in the ultra-violet region, say from λ4,000 to λ1,000 photography is practically the only available means for obtaining a record. In the visible portion, say from λ8,000 to λ4,000 the eye and the photographic plate are each available. By photography Abney has recorded wave-lengths as great as 27,000 Angstrom units.

In the infra-red region, that is for wave-lengths greater than 8,000, the bolometer, the radiomicrometer, the radiometer and the linear thermopile have all been used to good purpose. Rubens employing a linear thermopile has pushed his measures to λ61,000. But photography is probably more used than all other methods put together.

5. Comparison and Interpretation of Radiations.— Let us suppose that the lines in the spectrum of a certain body have been analyzed and recorded, it may be only for the moment on the retina of the eye, it may be permanently upon a photographic plate. The next step is to apply this information to the purpose for which it was obtained. To this end, the observer generally makes one of the five following comparisons:

(*a*) A comparison of the spectrum in question with itself when the radiation is produced under different conditions. Thus by comparing the ordinary spectrum of the sodium flame with that of the same flame in a strong magnetic field the Zeeman effect was discovered. By comparing spectra of the same star taken at short intervals of time Pickering discovered a new class of double stars called "spectroscopic binaries."

(*b*) A comparison of the spectrum in question with the spectra of other bodies. Thus a spectrum of iron, placed alongside of solar spectrum of the same scale, convinces one that there are many lines in the two spectra which coincide in position; and that, therefore, iron is probably one constituent of the sun.

(*c*) A comparison of the spectrum in question with some spectrum predicted by theory. Thus Keeler established Maxwell's view of the constitution of Saturn's rings by comparing the spectrum of these rings with the spectrum predicted by Doppler's principle.

(*d*) A comparison of the spectrum in question with the same spectrum recorded in other ways. Thus Lewis compares the infra-red spectra of sodium as obtained from the photograph, the phosphorograph, the bolometer, the radiomicrometer, with that predicted by Kayser and Runge's formula.

(*e*) A comparison of the spectrum in question with a standard scale of wave-lengths, that is, with an ideal spectrum in which each line differs from its nearest neighbor by exactly one Angstrom unit. The most beautiful examples of this comparison are to be found in the maps of the solar spectrum prepared by Rowland and by Higgs.

Concerning the interpretation of spectra, it must be frankly admitted that this is the most difficult part of the entire subject, demanding as it does wide experience in the laboratory and judgment of the highest order. Apparently no theory is so fanciful but it may find some support among the varied and complex phenomena presented by the spectroscope. The science of optics is controlled by a well-established theory, while spectroscopy must still be classed as an almost purely empirical science.

6. Summary of Principles.— There are, however, some general principles which have been fairly well established. Following are the more important ones:

Spectra of Gases.— The emission spectrum of a gas can be obtained, in general, only by passing an electric current through the gas. The emission spectrum of a gas is practically always a spectrum of bright lines. The emission spectra of solids and liquids are practically always continuous. As illustrating exceptions to this general law may be cited the fact that Paschen using the bolometer has obtained the characteristic radiations of carbonic acid gas heated by streaming through a hot platinum spiral; also the fact that the spectra of gases under very high pressures become nearly continuous.

Kirchhoff's Law.— Let us denote by H the amount of radiant energy, say heat or light, of any one wave-length which falls upon a body at temperature t° in one second. Let h denote the energy of the same wave-length which this body absorbs in one second when at the same temperature. The ratio h/H is what Kirchhoff calls the "absorption" of the body, and is denoted by A. A body which absorbs all the heat falling upon it is said to be "absolutely black"; its absorption is unity. Let us now denote by E the amount of energy of the same wave-length which this same body would radiate in one second. This quantity is called the "emission" of the body. Now Kirchhoff, in 1859, proved that:

(1) The ratio of the emission to the absorption of any body depends upon the temperature only; and

(2) This ratio is numerically equal to the emission of an absolutely black body at the same temperature.

By means of these two general principles Kirchhoff was enabled to explain the fact that a sodium flame placed between one carbon pole of an electric arc and the slit of the spectroscope will produce two dark absorption lines in the orange of the continuous spectrum exactly where, without the arc, it would produce two bright lines. But what is more important, Kirchhoff succeeded in explaining, on these same principles, the dark lines which Fraunhofer mapped in the spectrum of the sun. The continuous part of the solar spectrum is supposed to be due to the bright, underlying layers of the sun, which are under great pressure; while the dark lines — the so-called Fraunhofer lines — are due to absorption of the cooler gases which surround the sun. In the same manner may be explained the dark lines which appear in several classes of stellar spectra.

Doppler's Principle.— If we denote by v the speed with which any radiant source is approaching the observer, by V the speed of light, and n the number of waves of length λ emitted per second by the source, then it is evident that the n vibrations which the source emits in any one second will be distributed over a distance numerically equal to $V-v$. Hence the wave-length of the light, λ, which reaches the observer will be

$$\lambda = \frac{V-v}{n} = \frac{V}{n}\left(\frac{V-v}{V}\right) = \lambda_o\left(\frac{V-v}{V}\right).$$

It is evident, therefore, that the wave-lengths of light coming from a star which is approaching the observer will be shortened in the ratio $\frac{V-v}{V}$. In like manner, if a star be receding V from the spectroscope the wave-lengths will be increased in the ratio $\frac{V+v}{V}$. This principle, first enunciated by Doppler in 1843, enables the astrophysicist to measure rates of approach and recession. Recent work by Frost and Adams shows that the speed of a star in the line of sight can be determined with an error not exceeding one-half mile per second. In like manner the relative motion of the two limbs of the sun and of several of the planets, and hence their periods of rotation, have been determined by the spectroscope. Even in the very faint spiral nebulas, the rotation and the nature of their motions in space can in some cases be found, thus throwing a flood of light on the nature of these bodies and on the possible development of stars from them.

Effect of Pressure.— In 1895 it was proved by Humphreys and Mohler, from measurements made in the physical laboratory of Johns Hopkins University, that the wave-length of a line in the spectrum of any element is dependent upon the pressure of the medium surrounding the source. Thus when the cadmium arc is worked under a pressure of 10 atmospheres the cadmium lines are shifted toward the red end of the spectrum about 0.07 of an Angstrom unit. In general, the amount of this shift is toward the red, directly proportional to the wave-lengths in any one element, and directly proportional to the excess of pressure above one atmosphere.

Effect of Atmosphere Surrounding Source.— It has been shown by Crew, Basquin, Porter and Hartman that the spectrum of an electric arc between two metallic electrodes is very distinctly affected by surrounding it with an atmosphere other than air. In the case of hydrogen, it has been shown that the lines affected by the hydrogen atmosphere belong to the spark spectrum of the metal. It is also true that the lines which belong to Kayser and Runge's series are not affected by the change from air to hydrogen. It has been suggested that this effect may account for the peculiar spectra of many of the so-called «hydrogen stars,» that is, stars in which the hydrogen spectrum is very strong.

The Zeeman Effect.— In 1896 Zeeman, then at Leyden, made the capital discovery that if a source of radiation be placed in a magnetic field each individual line in its spectrum will in general become a triplet with the two side components circularly polarized and the middle component plane polarized.

Temperature Effects.— The rôle which temperature plays in the production of line spectra is very little understood. It is, at present, impossible to say to what extent the various characteristics of flame, arc or spark, spectra depend upon temperature, upon chemical action and upon electrical conditions. But in the case of solid bodies, which yield a continuous spectrum, Stefan showed, in 1879, that the total radiation varies as the fourth power of the absolute temperature. And it has since been established by Wien that, if we denote absolute temperatures by T, $\lambda_m T =$ constant and $I_m = T^5$ constant where λ_m indicates the wave-length at which the radiation is a maximum and I_m represents the value of the maximum radiation. These two important laws are merely inferences from a still more general expression which Wien has established.

Law of Spectral Series.— Soon after the discovery was made that there exist in the spectra of the elements certain series of lines distinguished by certain common characteristics, Balmer succeeded in devising a single formula which gives, in a very exact manner, the wave-length of each of the hydrogen lines known to him at that time. The expression is as follows:

$$\lambda = \lambda_0 \left(\frac{m^2}{m^2-4}\right)$$

where λ_0 is a constant and m denotes the natural numbers beginning with 3. This formula has since shown itself competent to describe accurately the 29 hydrogen lines which are now known.

In 1888 Kayser and Runge began a remarkable study of the arc spectra of many of the more important elements and showed that most of these elements contain one or more series of lines capable of representation by the following formula:

$$\frac{1}{\lambda} = A + Bm^{-2} + Cm^{-4}$$

in which A, B and C are constants for each series, and m denotes the natural numbers beginning with 3. Each different chemical element has its own different characteristic values for these three constants. This fact is the foundation of spectrum analysis.

Rydberg has shown that the following expression is equally effective in representing the facts:

$$\frac{1}{\lambda} = A + \frac{B}{(m+\mu)^2}$$

where A, B and μ are constants for each series, while λ and m have their previous meanings. Thus in the case of *Mg*, *Zn* and *Cd* there are six such series, in each case equivalent to two series of triplets. It is to be hoped that this great advance will be followed some day by a dynamical explanation of the vibrating atom, which will include these two formulæ as rigidly derived inferences.

Bibliography.— In the way of general treatise, consult Kayser, 'Handbuch der Spectroscopie' (Leipzig 1900), as incomparably the most complete and scholarly work in existence. Here may be found references to the literature of every part of the subject. For a complete theory of the plane grating consult Rowland, 'Physical Papers.' A most elegant and simple theory of the concave grating is given by Runge in Kayser, 'Handbuch der Spectroscopie.' On the general theory of the spectroscope consult a series of papers by Wadsworth in the 'Astrophysical Journal,' Vol. I *et seq.* An excellent treatise on stellar spectra is Scheiner, 'Astronomical Spectroscopy,' translated into English by Frost (1894). Solar spectroscopy is treated by Young in 'The Sun' (International Scientific Series) and by an important series of papers by Hale running through the 'Astrophysical Journal' from its beginning up to 1916. A very large number of additional papers of value will be found in the 46 volumes of the last-named publication.

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SPECTRUM ANALYSIS. See Spectroscopy.

SPECULARITE. See Hematite.

SPECULUM. (1) *In optics and astronomy,* a polished surface usually made of a metallic alloy that admits a high polish and resists corrosion and formed either flat or curved, for reflecting images. Specula are employed in large telescopes as reflectors. (See Telescope). (2) *In medicine and surgery,* an instrument for opening a part or passage of the body, especially for dilating an orifice, and introducing a reflector, so that in combination with a light the interior can be viewed. It is used to facilitate examinations and operations.

SPECULUM METAL. See Mirror.

SPEDDING, spĕd'ĭng, **James,** English editor and author: b. Mirehouse, Cumberland, 26 June 1808; d. London, 9 March 1881. He was graduated from Trinity College, Cambridge, in 1831, was long an honorary Fellow of his college, from 1835 till 1841 was employed in the Colonial Office and in 1842 was secretary to Lord Ashburton's mission to the United States for the settlement of the northwest boundary dispute. On the formation of the Civil Service Commission in 1855 he became its secretary. In 1847 he undertook, with the collaboration of R. L. Ellis and D. D. Heath, to prepare a complete edition of Bacon's works; but the former died while the task was unfinished and the latter only gave occasional assistance. The work, therefore, was almost entirely left to Spedding, who completed and published his labors in seven volumes (1857–59). This done, he published ‹The Life and Letters of Bacon› (1861–74); ‹Reviews and Discussions, Literary, Political and Philosophical, Not Relating to Bacon› (1879); and ‹Studies in English History› (with J. Gairdner, 1881). Leslie Stephen has called Spedding's Bacon «an unsurpassable model of thorough and scholarlike editing.» Consult the ‹Life› by Venables appended to the edition (1881) of ‹Evenings with a Reviewer,› privately printed by Spedding in 1845 and republished (London 1881).

SPEE, Maximilian, Count von, German admiral: b. Copenhagen, Denmark, 1861; d. off Falkland Islands, 8 Dec. 1914. He was one of Germany's leading naval strategists and was credited with a prominent part in perfecting the plan by which in case of war the scattered warships of the German navy were to assemble. The plan went automatically into effect upon the outbreak of the European War, and the command of the fleet thus gathered fell to Von Spee. He surprised and defeated the British squadron under Admiral Cradock off Coronel, Chile, 1 Nov. 1914. He was in turn attacked and his fleet destroyed by a British fleet under Rear-Admiral Sir Frederick Sturdee off Falkland Islands, 8 Dec. 1914. Von Spee went down with his flagship, the *Scharnhorst.*

SPEECH, the production of articulate sounds by the voice organs; it consists in tones of voice modified by the agency of the tongue, cheeks, lips and other structures intervening between the glottis and the outer opening of the mouth. The modifications of articulate sounds which may be invented and used by man are almost without limit; the modifications actually used in the ordinary speech of all mankind numbers at least a thousand, and a universal language would have to provide symbols representative of that many speech sounds. Nevertheless, the number of distinct sounds in any one language seldom exceeds 50. In English speech two classes of sounds are produced, known as vowels and consonants. Vowels are pronounced by sounds coming primarily from the larynx; consonants are formed by sounds due to interruption of the currents of air in the mouth or passages above the larynx. The name consonant denotes a sound that cannot be produced effectively without the aid of a vowel. The vowels are further distinguished by the fact that they can be sounded mutely, or in a whisper. The differences between vowel sounds are owing to differences in the dimensions of the space between tongue and palate (mouth cavity) and of the mouth opening, when the vowels are pronounced, as shown in the following table:

Vowel		Sound	Size of mouth-opening	Size of mouth-cavity
a	as	in *far*	5	3
e	as	*ei* in *vein*	4	2
i	as	in *marine*	3	1
o	as	in *cold*	2	4
u	as	*oo* in *moon*	1	5

Vowels sounds can be prolonged indefinitely; so may some consonants, as l, m, n, r, s, z, etc.; but others as b, p, t, d, k, g hard, cannot be prolonged. Absence of the sense of hearing prevents the perception of sounds and also their imitation — hence persons born deaf are necessarily dumb, but through training such persons may acquire the power of speech. Where dumbness exists without deafness the affection is due to some disorder of the nerve centres. See Language, Science of; Voice and Voice Culture.

SPEECH, Defects of. Speech is an extremely complex and intricate mechanism, and in the normal adult represents a large number of various factors. Its defects, therefore, are equally complex. In ordinary speech at least three separate types of processes are involved: (1) sensory; (2) motor, and (3) intellectual or associational.

(1) The sensory mechanism of speech includes all the avenues by which the idea of a verbally expressible picture can get into the brain. The eye and the ear are mostly used because with these senses the pictures are most distinct, but touch, smell or other sense, if recognized, may be of use in the faculty of speech. Thus with the sensory portion of the speech-mechanism the intellectual factor must necessarily be joined. One sees the words on a printed page and pronounces them; but if written in a script to the reader unknown, he can see the characters and yet will not be able to utter the sounds they represent.

(2) The motor side of speech implies (*a*) the ability to use the muscles of speech and (*b*) the power of co-ordinating those muscles so as to say the right things. The lips, the

tongue, the larynx, the teeth are the organs mostly used in speech. One may say that in deaf-mutes the hands are organs of speech. The nerves that govern the muscles ordinarily used in speech are the motor cranial nerves, the nuclei of which are located in the medulla oblongata (q.v.); but the centre that co-ordinates their movements with the sensory impressions which come in through the organs of special sense, as well as with the intellectual concepts concerning the things seen, heard or touched is located in the third frontal convolution or Broca's convolution. This is the chief motor centre for speech.

(3) The intellectual factor in speech implies the action of co-ordinating and associational fibres in the human brain that pass from the sensory centres to the motor centres. It is the factor that governs, as it were, the knowledge of what one is saying. One may repeat from the hearing a line of Choctaw, but without understanding it: the intellectual factor is here non-operative. Memory-images of many kinds may be reproduced by appropriate stimuli; and defects in certain parts of the brain interfering with the bringing out of the memory-images by which a sound is associated with its cause, or an object with its name, occasion certain well-defined disorders of speech. The act of speaking, therefore, requires: (*a*) the power to think or to construct an idea; (*b*) the capacity to recall and to formulate the word or words which express the idea; (*c*) the ability to articulate the sounds in an understandable or conventional manner.

It is customary to use the word aphasia to denominate true defects of speech. Defects in the incoming sensory tracts, which must modify speech in some respects, are not usually included in this category. In the same manner defects in nervous supply of the muscles of speech, such as paralysis of the tongue, are not termed aphasia. Again, a purely intellectual defect, as in idiocy, whereby speech is seriously affected, is not classed as aphasic. Seglas has divided the disorders of speech into three groups: (1) dylogias, or the disorders of intelligence which affect speech — as seen in idiots, imbeciles, etc.; (2) dysphasias, or true affections of speech (aphasias) — the most interesting and complicated; (3) the dysarthrias or the disorders of articulation — such as are seen in stuttering, in the peculiar speech of deaf-mutes, in the speech of bulbar palsies, of facial paralyses, etc.

The aphasias are the defects of speech that involve the association-tracts and the sense-centres and have been most exhaustively studied. Speaking generally, the true aphasias may be classed in three broad groups: (1) the receptive or sensory aphasias, which result from some injury to the centres for sense-memories of things heard, seen, smelt, tasted, touched, etc.; (2) the conduction-aphasias, which follow injury to the conducting fibres in the brain that pass from a sense-centre to

Chart.—(From Langdon, 'Aphasia').

Aphasia	Receptive or "Sensory"	Auditory aphasias	1. Amnesia verbalis (word deafness), the non-recognition of word sounds.
			2. Amusia (music deafness), non-recognition of musical sounds.
			3. Auditory apraxia (object deafness), non-recognition of object sounds.
		Visual aphasias...	4. Alexia (word blindness), non-recognition of word meanings.
			5. Visual apraxia (object blindness), non-recognition of object meanings or uses.
			6. Visual amimia (pantomime blindness), non-recognition of word or pantomime mimicry.
		Olfactory aphasias.......	7. Cortical anosmia (smell memory loss), non-recognition of objects by smell.
		Gustatory aphasias.......	8. Cortical agusia (taste memory loss), non-recognition of objects by taste.
		Myotactic aphasias.......	9. Myotactic alexia (word anæsthesia), non-recognition of word movements by finger or pen.
			10. Myotactic amimia (pantomime anæsthesia), non-recognition of mimicry by touch.
			11. Myotactic apraxia (object anæsthesia), non-recognition of objects felt.
	Conduction, "Associational"	Auditory paraphasia.....	12. Paraphasia verbalis (spoken word forgetfulness), non-recollection of word sounds.
			13. Paramusia (musical sound forgetfulness), non-recollection of musical sounds.
			14. Auditory parapraxia (object sound forgetfulness), non-recollection of object sounds.
		Visual paraphasia.....	15. Paralexia (word meaning forgetfulness), non-recollection of word meanings.
			16. Visual parapraxia (object meaning forgetfulness), non-recollection of object meanings.
		Olfactory paraphasia.....	17. Parosmia (smell memory forgetfulness), non-recollection of smell meanings.
		Gustatory paraphasia.....	18. Parageusia (taste memory forgetfulness), non-recollection of taste meanings.
		Myotactic paraphasia.....	19. Myotactic parapraxia (object touch forgetfulness), non-recollection of feel of objects.
			20. Myotactic paramimia (pantomime forgetfulness), non-recollection of mimicry movements.
		Concept aphasia.......	21. Anomia (name memory loss), non-recognition of names of objects.
			22. Paranomia (name forgetfulness), non-recollection of names of objects.
	Emissive, or "Motor"	Spoken..........	23. Psychic motor aphasia (spoken word construction lost), loss of psychic spoken word plans.
			24. Executive motor aphasia (spoken word utterance loss), loss of spoken word motor memories.
		Written.........	25. Psychic agraphia (written word construction loss), loss of psychic written word plans.
			26. Executive agraphia (written word utterance loss), loss of written word motor memories.
		Pantomimic.....	27. Psychic amimia (pantomime construction loss), loss of psychic word mimicry plans.
			28. Executive amimia (pantomime utterance loss), loss of word mimicry motor memories.

the motor centre; (3) emissive or motor aphasia, which is produced by an injury to the motor cortex chiefly of Broca's convolution. Some 30 different types of aphasic disorder of speech are known and may be summarized on the chart here given; but some of the commoner forms of aphasia may be mentioned. Of the receptive or sensory type, amnesic aphasia, or word-deafness, is one of the most characteristic. In all of the sensory aphasias there is a loss of comprehension of the words heard or read. In amnesic aphasia the patient hears very distinctly everything that is said, but it might as well be in a foreign tongue, because of the disorder of the centre for word-memory pictures in the temporal convolution. The patient usually speaks, but makes many lapses, not knowing just what he is saying and on hearing his own speech not understanding it. Many varieties of this defect are known. They should be studied in special monographs (see chart for varieties). In the conduction or association aphasias or paraphasias, the association-fibres connecting one speech-centre with another are interfered with. Any of the types may be present, but the form most often seen is one in which the tracts between the auditory centres and the motor speech-centre is involved. Here the patient is aware of the words, knows what they mean and tries to speak, but speaks incorrectly; his path seems to be blocked. The commoner type is motor aphasia. In this Broca's convolution is affected. The patient here sees and hears and comprehends, but is unable to speak the words. He is likewise unable, as a rule, to write the words he sees or hears, and hence suffers from agraphia as well. Many common expressions, as «yes» and «no,» «good-morning,» «good bye,» etc., may be retained. The mechanical necessities that underlie many intellectual processes are clearly brought out in the study of aphasia; and in no other manner is the knowledge driven home how dependent one is on the proper working of certain centres and tracts, as in the study of the defects of speech. Consult Lichtheim, ‹Aphasia, Brain› (1895); Elder, ‹Aphasia and the Cerebral Speech Mechanism› (1897); Bastian, ‹Aphasia and Other Speech Defects› (1898); Pick, ‹Proceedings of 10th International Congress› (Paris 1900); Dejerine, ‹Semeiologie des Maladies Nerveuses› (1902); Baldwin, ‹Dictionary of Philosophy and Psychology,› article ‹Speech and its Defects› (1902–04); Jelliffe and White, ‹Diseases of the Nervous System› (3d ed. 1919).

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SPEECH, Figures of, deviations from the usual order of words in a sentence or from their common and literal sense. These deviations are employed to give vivacity to language in some form or another. Often comparatively primitive languages are rich in bold and imaginative figures of speech. This is because youth is, in language as in races and men, the period of imagination, the time when the human mind works untrammeled by the restraint of the knowledge of the physical laws of nature. The life of primitive man was filled with images, passions, personal interests, loves and hates. These images he was continually creating out of his experiences or his want of experience. The moment he departed from the familiar facts and experiences of his life, his childish, untrained mind began to picture things, conditions and results outside the common. This habit of expressing out of the ordinary feelings and conditions of life by out of the ordinary forms of language has remained with the race in its most advanced stages. These figures of speech have been modified and refined; but for all this they still retain much of the boldness of their primitive origin. As the imagery of the more primitive races is always the expression of thoughts and images vividly in the mind, and as it is never forced, it is generally true to the thought itself and to the image which graphically presents it. But this is far from being true of the imagery of more advanced races who have borrowed much from the past, often retaining the form after the cause that called it into being has been forgotten. The requisites of proper figures of speech exact that every comparison should be the result of a real likeness clearly presented in an apparently spontaneous manner. It is a general rule that the more marked the difference between the objects compared the greater the contrast and, therefore, the stronger the effect. As this effect should be practically instantaneous upon those to whom the figure of speech is directed, it follows that, as a general rule, it is best not to specify difference, because these details divert the mind from the sudden effect desired. Every word that truly belongs to a language possesses a denotative and a connotative sense. The former expresses the meaning and uses which good society has given it; the latter presents the atmosphere which clings to words, causing them to express thoughts, ideas and associations apart from their ordinary accepted use. Connotation gives us, very often, our must suggestive and beautiful figures of speech and lends to poetry and rhetorical prose much of their attractiveness and grandeur. In treating of figures of speech it is customary to divide the subject into figures of resemblance, figures of contrast and figures expressing other relations than either of the above. The figures of resemblance include the simile, metaphor, allegory and personification. Those of contrast embrace antithesis and epigram. The third classification includes metonymy, synecdoche, apostrophe, exclamation, interrogation, hyperbole, climax, irony, vision, euphemism, onomatopœia, litotes, parallel, allusion and alliteration. A simile expresses resemblance between things that are different. In the metaphor this comparison is implied but not formally expressed; while in the allegory, which is a story couched in symbolical language, the comparison is expressed much more at length than in either the simile or the metaphor. Personification, on the other hand, attributes life to inanimate things and abstract ideas. By its very boldness it merges the idea of resemblance in the animation of the thing personified. Antithesis, as its name implies, is a figure existing by virtue of the contrast of words employed in a sentence, while an epigram, though based upon contrast, is inclined to hide this word-contrast by throwing the force of the contrast upon some general idea of contrast in the statement or situation. An epigram, which formerly signified an inscription on a monument, has come to have the sense of a brief pointed saying, generally in the nature of a proverb. Metonymy, which literally means the employment of one name for another, is expressed by substituting the container for the thing contained, the sign for the thing signified, the cause for the effect or the effect for the cause; while synecdoche substitutes a part for the whole or the whole for a part. Apostrophe, being simply a form of address, is frequently used with other parts of speech, more especially metaphor and personification. It addresses the absent as if present and treats the dead as if they were living, and inanimate things as though possessed of life. Interrogations are frequently used for rhetorical effect rather than for the purpose of getting an answer, and in this case they form true figures of speech. In the same way when an exclamation expresses deep feeling, more especially in a condensed form and unusual order, it presents itself in the form of a figure of speech, because it is so arranged as to powerfully attract the imagination. Hyperbole expresses that things or conditions are better or worse, greater or less than they really are, for the sake of the effect thus produced. It is, therefore, historical exaggeration. A climax presents a series of statements or thoughts in the rising order of their importance. When they are presented in the decreasing order of their importance the rhetorical figure is termed an anti-climax. Irony conveys a meaning contrary to the one suggested by the ordinary sense of the statement. Vision, which frequently accompanies apostrophe and personification, presents scenes as though before the eyes although they are past, or imaginary or absent. Euphemism is the name given to that figure of speech whereby an agreeable presentation is given to something that is in itself disagreeable. Onomatopœia adapts the sound of words to their use and meaning. When a statement is made by denying the opposite of what is affirmed the figure of speech thus employed is called litotes. A parallel is an extended antithesis, which continues the comparison of two similar objects, while allusion simply refers to some familiar event or expression by way of explanation or illustration. Alliteration, which is frequently called a figure of emphasis, is the repetition of the same initial sound in a succession of words. It is frequently used in poetry; but it was more commonly employed in more primitive days of the art than at present. See RHETORIC.

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SPEECH, Genesis of, or the Origin of Language.* Of these alternative titles the latter is the broader, since «language» is used of the expressive movements of any part of the body (compare the term Gesture Language), while «speech» is applied only to expressive movements of the vocal organs. The term «Genesis» is more appropriate than «origin,» because the latter implies that speech proceeded from a condition in which speech did not exist, whereas, go back as far as we may in the evolution of animal life, we shall never find a stage in which all of the essential elements of speech are absent. «Genesis» on the other hand suggests the earlier stages of a long and continuous process of development that eventually led to the present highly complex forms of human speech. The phrase «Origin of Languages» sometimes occurs to express the fact that many languages doubtless arose independently in primitive times. The general problem involves two main questions: (1) What was the genesis of the speech movements? (2) How did the speech movements come to be expressive of thought, i.e., of sensations (ideas) and feeling (emotions)? There is really a third question involved: what is the genesis of the ideas and emotions? While ideas and feelings are thought of not as language but as that which is expressed by language, yet it should be remembered that the sensations of sound, the kinesthetic sensations and the mental pictures written and printed words, all of which are indisputably a part of language, are mental processes of essentially the same type as those other ideas which we usually call thought. As a matter of fact the problem of the genesis of speech has usually been confined to the second of the above questions, the other two being left as preliminary problems to the physiologist and the psychologist. As a matter of fact all three are essentially psychological problems.

It is generally held by psychologists that every emotion and probably every other mental state tends to pass over at once into movement. By virtue of the necessary relationship existing between the mental state and the movement the latter becomes symbolic of the former, i.e., the movement is an expressive movement. The connection between the nervous state and movement is very ancient, or, at least, has very primitive antecedents. The simplest monocellular animals, such as the paramecium, which has not even an especially developed nervous system, responds consistently by certain definite movements to certain definite stimuli, and even plants possess irritability: that is, response to environment by movement,— which movement is less in plants than in animals primarily, as it would seem, because their cell walls are more rigid than those of animals. Movements of the speech organs (and speech organs similar to those of man occur in nearly all the air-breathing animals of higher rank than the amphibians) are under the same kind of nervous control as all other muscular movements. As the movements of all animals and even of plants are primarily life-serving movements, it is natural to suppose that all movements had their origin in responses to environment of such a character as to continue the life process. A plant turns to the light, which is the source of the energy by which it makes its food; the paramecium swims away from a poisoned area in the water and moves toward its food. Perhaps chemical and mechanical laws account for these movements. In the case of the lowest animals that possess lungs and a larynx the power of movement is already very highly developed and specialized and under the control of a highly developed nervous system. All animals that possess a larynx make with it movements which produce air vibrations of a frequency within the range that is appreciable through the ear as sound. Birds and quadrupeds produce loud and complex sounds which appear to play an important part in lives of these animals. Undoubtedly man inherited from his pre-human ancestors the power of producing sounds by the movements of his laryngeal and breathing muscles. The range of sounds which animals are capable of producing with their vocal organs is far greater than has usually been supposed. This fact is fully established in the case of apes, which have been more fully investigated in this respect.

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* NOTE — Before reading this article, section A of the article, LANGUAGE, SCIENCE OF, should be studied.

Some scholars have assumed that the cooings, gurglings and musical notes made by infants in such great variety before they learn to speak represent a condition in which primitive man found himself before speech was developed. On the contrary these infant cries are doubtless the outcome of a high state of development of the laryngeal muscles and extensive nervous connections which the child inherited from his parents in whom the power of speech was, of course, highly developed. It would be valuable to know how an infant's vocal movements compare in complexity with those of an ape. Phonograph records could be made of both.

Whether the pre-human was capable of using his speech organs for the expression of thought is a question which we can answer to no fuller degree than we can solve the same question in the case of animals. A fundamental question is whether animals, and, therefore, pre-humans (creatures higher than existing animals and still lower than man) had the capacity to think. Psychologists who have especially investigated the mental processes of animals believe that the more intelligent animals (rats, for example) perform with their brains all the different kinds of processes that men perform, the chief difference between the animals and men being one of relative complexity rather than one of kind. The question has often been raised as to whether thought antedated language in the evolutionary process or vice-versa. All that seems positively affirmable on this point is that language (i.e., expressive movements) and intellectual life developed side by side. Neither preceeded the other. Indeed the two together form one complex psychophysical process. Ideas and feelings are as inconceivable without expressive movement as is expressive movement without ideas and feelings to be expressed. We may assume that an animal's movements are a fairly adequate expression of his mental life, just as the more elaborate vocal movements of man are a fairly adequate expression of his more complex mental activities. The problem as to how speech movements (and their resulting sounds) gained meaning has been the subject of very extensive discussion. The problem arises from the fact that, while most expressive movements other than speech and not based upon it contain within themselves some element or elements more or less directly related to the meaning and naturally suggestive of it, in the case of speech movements no such relationship exists except in a small group of onomatopoetic words, in which, however, the relationship is merely secondary, i.e., not between the movement and the meaning but between the sound (which is a secondary product of the movement) and the meaning. For example, neither the movements of the vocal organs which form the word «dog» nor the sounds of the word nor yet the written or printed symbol bear the faintest resemblance to the object signified. Latin *canis*, German *Hund*, French *chien* and Russian *sobaka*, words entirely different in movement, sound and appearance, and likewise bearing no resemblance to a dog, serve equally well. The connection between the movement and the meaning is purely arbitrary. On the other hand a gesture, such as pointing, is universal among men and is intelligible everywhere. Further, when an Indian puts two fingers of one hand astride one finger of the other to indicate a man on horseback, or when he puts his hand over his head to signify white man (i.e., one who wears a hat) the connection is still clear.

Various attempts have been made to account for this arbitrary (associational) connection between movement and meaning. (1) Some scholars bridged the gap by assuming that the Creator implanted the gift of speech in man. This in its literal sense is, of course, absurd. Equally absurd, though not so conspicuously absurd, is (2) another «fiat» view of the case, which assumes that groups of men came together and by deliberate choice selected certain sounds to express certain meanings. Such an act is conceivable only among men who already possess the power of speech. With more justification (as might superficially appear) it has been urged that (3) men imitated characteristic sounds produced by objects in the outside world — the so-called «bow-wow,» or onomatopoetic theory. More far fetched is the suggestion that men (4) naturally «rang out» the sound characteristic of an object when struck — the «ding-dong» theory. Others assumed that (5) instinctive cries came to be associated with and hence to symbolize the situation or object which produced them — «pooh! pooh!» theory.

All these theories must be regarded as attempts to conjecture how speech might conceivably have arisen instead of as anything even remotely approaching a scientific demonstration of how speech actually did arise. Against the third theory it may be urged that at best it would account for the origin of but very few words. Furthermore it has been shown that of even this relatively small number of words, some have attained an onomatopoetic character in comparatively recent times, having arisen by changes of movement from words that formerly had quite different sounds, and hence could not be used to substantiate this theory.

In so far as these theories attempt to assign a method of origin to individual words, they are open to the objection that, while we cannot say positively what type or types of thought were employed during primitive, incipient stages of human or pre-human speech, still in all likelihood in these earlier stages (and this seems to hold true of animals also) man had occasion to express only masses of ideas, whole situations as yet unanalyzed into detailed ideas such as are expressed by most modern words. A difficulty of the last theory lies in the relatively small number of emotional cries found in a single individual, unless we include the meaningless cries of children mentioned above, with the consequent objections. The last theory also assumes the existence of speech sounds before thought, which, as was stated above, is as untenable as the converse assumption.

In contrast with these five theories a more scientific attempt to explain the arbitrary connection between speech movements and meaning regards the former, like other gestures, as worn-down remnants of movements that were previously useful (life serving). F. N. Scott (in 'Publications of the Modern Language Association of America') has called attention to a variety of such movements of the speech organs, for example, panting, gasping, grunting, sneezing, coughing, choking, etc. The closing of the glottis necessarily precedes all great muscular efforts of the body. The cessation of such effort is followed by its opening. The necessity of breathing during the strain necessitates gasping. Many such movements occur in typical situations and in accordance with the normal working of the mental processes would soon become closely associated with them.

Movements of the speech organs productive of sound waves occur also in connection with other movements that are life serving. Panting, for example, follows upon all vigorous exercise. The sounds thus produced, through association with the movements which produce them and further with the movements which the latter accompany, become also associated with, and hence significant of, the general situation under which they arise. In the cases mentioned the connection between the two groups of concomitant movements is purely physical. There are, however, other groupings, the connection between which lies in the nervous system. Such secondarily produced movements (whether of the vocal organs or other muscles) are explained by psychologists as due to the «overflow» of exceptionally intense feeling into other nervous channels than those within which they would naturally be supposed to be confined. Instances of such complexes of movement occur in animals. This view provides no final explanation, however, because it at once suggests the question why and how the nervous connection between the two movements arose, i.e., why the overflow took originally the precise channel which it did.

On the other hand there are sound-producing vocal movements which may be instinctive in origin and which are also useful in that they contribute to the survival of the individual and hence of the race. The various calls of animals are of this kind, signifying, as they do, «danger!» «food,» etc. Pre-humans doubtless possessed such calls. Assuming that these movements represented in their earlier stages unanalyzed general situations, it is easy to see how (as mental powers developed in complexity and the consequent analysis of the general situations brought specific elements into clearer consciousness) the specific dominating elements rather than the general complex came to be symbolized by the vocal movements, thus giving origin to expressions more akin in meaning to the majority of existing words.

In general it may be said that the methods of modern science (as applied both in psychology and in linguistic study) constrain the student of the genesis of speech to confine himself in his search for positive evidence to such linguistic processes as occur in the experience of people now living. This is the only kind of first-hand evidence which can be fully studied by direct examination and which admits of even approximately exact scientific control. Thus the evolutionary processes which are at present taking place form the only safe criteria from which one may draw inferences as to the conditions that prevailed in earlier times. Probably we shall never be able to reconstruct such primitive conditions in detail; we will be limited to the possession of certain general truths concerning their nature. In all study of this subject furthermore one must be continually guided by our best contemporary understanding of the mental processes.

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SPEED, James, American politician: b. Jefferson County, Ky., 11 March 1812; d. there, 25 June 1887. He was graduated from Saint Joseph's College, Bardstown, Ky., in 1828, studied law at Transylvania University and in 1833 engaged in practice at Louisville, Ky. He was elected to the legislature in 1847 and as State senator in 1861 he took an uncompromising stand against the proposed secession of Kentucky. Later he was in charge of recruiting stations in Kentucky. He was appointed attorney-general by Lincoln in 1864 and continued in office until 1866 when he resigned to resume his law practice and his professorship in Transylvania University. He served as delegate to the Republican national conventions of 1872–76, but otherwise held no further public office.

SPEED, John, English antiquary: b. Farringdon, Cheshire, 1552; d. London, 28 July 1629. He was taught his father's trade of tailoring, and in 1580 was admitted to the freedom of the Merchant Taylor's Company. His earlier occupation aside from the practice of his trade was the drawing of maps, and in 1608–10 he published a series of 54 'Maps of England and Wales.' These reappeared with descriptive texts as Speed's 'Theatre of the Empire of Great Britaine' (1611) and were subsequently issued in several editions. His next work was 'The History of Great Britaine Under the Conquests of Ye Romans, Saxons, Danes and Normans, . . . with the Successions, Lives, Acts and Issues of the English Monarchs from Julius Cæsar to . . . King James.' This work places Speed as the first English historian in distinction from the annalists and chroniclers of preceding times, but in accuracy the work left much to be desired. He published also 'Genealogies Recorded in Sacred Scripture'; 'A Cloud of Witnesses

. . . confirming unto us the Truth of the Histories in God's most Holie Word' (1616).

SPEED, John Gilmer, American journalist: b. Kentucky, 21 Sept. 1853; d. Morristown, N. J., 2 Feb. 1909. He was graduated from the University of Louisiana in 1869, practised civil engineering for a time, joined the editorial staff of the New York *World* in 1877, was its managing editor, 1879–83 and subsequently editor of the *American Magazine* and *Leslie's Weekly*. His publications include 'A Fall River Incident'; 'The Gilmers in America,' and 'A Deal in Denver.' He also edited a volume of the poems of John Keats.

SPEED. See Mechanics.

SPEED AND SPORTING RECORDS. See Sports: Their Development, Speed and Record.

SPEEDOMETER, an instrument for indicating or recording the rate at which a motor vehicle is traveling. It is attached to the dashboard, within easy view of the driver, its mechanism being connected with the front wheels of the car. Improved types indicate not only the speed at which the car is traveling, but register the maximum speed reached and the total number of miles traveled.

SPEEDWELL, a genus (*Veronica*) of annual and perennial herbs and shrubs of the family *Scrophulariaceæ*. The 200 species are mostly natives of the north temperate zone; some, mostly shrubby, are tropical or subtropical, and others are Australian. They are found in all kinds of soils, and many are cultivated in gardens for their beautiful white, blue or pink flowers arranged in axillary or terminal racemes. The taller-growing kinds are used mainly as border plants, the dwarfed in rock-gardens; the shrubby kinds are ever-blooming in California. Some of the species were formerly reputed medicinal, and some were used as substitutes for tea.

SPEEDWELL, The, a sister ship of the *Mayflower*, which sailed for Plymouth, but was unseaworthy, and put back to port. See Mayflower, The.

SPEER, spēr, **Emory,** American jurist: b. Culloden, 3 Sept. 1848. He served in the Confederate army during the last two years of the Civil War; was graduated from the University of Georgia in 1869; studied law, and became solicitor-general of Georgia. He was a member of Congress from Georgia as an independent Democrat, 1879–81 and as Independent 1881–83; he was United States attorney, 1883–85; and was made a United States judge of the Southern District of Georgia in 1885. He was also president of the law department of Mercer University, and an orator of prominence. He is the author of a legal work on 'Removal of Causes from State to United States Courts' (1888), and of 'Lectures on the Constitution of the United States.'

SPEER, Robert Elliot, American religious leader and foreign missions secretary: b. Huntingdon, Pa., 10 Sept. 1867. He was graduated at Princeton University in 1889, later studied at the Theological Seminary there, and since 1891 he has been secretary to the Presbyterian Board of Foreign Missions. He made tours of the foreign missionary fields in China, India, Japan and Korea in 1896–97; in South America in 1909; and in Japan, China, Siam and the Philippines in 1915. He is widely known in missionary circles as an effective organizer. Author of 'Presbyterian Foreign Missions' (1901); 'Missions and Modern History' (2 vols., 1904); 'Christianity and the Nations' (1910); 'South American Problems'; 'John's Gospel' (1915), etc.

SPEICHER, Eugene Edward, American artist: b. Buffalo, N. Y., 5 April 1883. He studied at the Albright Art School, Buffalo, at the Art Student's League and the Henri Art School in New York, and later studied for two years in London, Paris, Holland, Italy and Spain. He established himself in New York, where he became prominent among the younger artists as a painter of landscapes and portraits. He was elected an associate of the National Academy of Design in 1913 and received the academy's first Halgarten Prize in 1915. He was also awarded a silver medal at the Panama Exposition in 1915. Among his works are portraits of Miss Helen Appleton (Thomas R. Proctor Prize, National Academy, 1911); Charles Dana Gibson (1913); John Nelson Cole (1914); and the landscape 'Morning Light' (Metropolitan Museum, New York 1912).

SPEKE, spēk, **John Hanning,** African explorer; b. near Ilchester, Somerset, 4 May 1827; d. near Bath, 15 Sept. 1864. In 1844 he entered the army and took part in the Sikh War. During his leave of absence he made hunting and exploring expeditions over the Himalayas and through parts of Tibet, collecting many specimens of animals, plants and minerals. In 1854 he accompanied Sir R. F. Burton (q.v.) and party in an expedition to Somaliland, He next served in the Crimean War, and at its close was invited by Burton to join him in an African expedition, to be carried out at the expense of the home and Indian governments. In June 1858, Speke and Burton proceeded inland from the east coast, their object being to ascertain the position of the great lakes of the interior, confused accounts of which had been from time to time received from the natives. The great lake Tanganyika (q.v.) was discovered, and Burton falling sick, Speke proceeded north and discovered the south end of the Victoria Nyanza (q.v.), which he correctly judged to give birth to the Nile. In 1860 he led another expedition, organized by the Royal Geographical Society, which explored the western and northern margin of the Victoria Lake, and found a river flowing out of the lake, which turned out to be the White Nile. After long delays in Uganda and Unyoro the travelers proceeded northward, and at Gondokoro met Sir Samuel Baker, who was leading an expedition southward. Returning home he was killed by the accidental discharge of his gun while out shooting. He published 'Journal of the Discovery of the Source of the Nile' (1863); and 'What Led to the Discovery of the Source of the Nile' (1864).

SPEKE'S ANTELOPE. See Bushbuck.

SPELLING, orthography, the formation of words by means of letters or alphabetic symbols. In certain languages like Spanish, for instance, the system of representing the sounds of the language by alphabetic symbols is practically perfect. In other words it is phonetic. In English, on the contrary, the multiplicity of vowel sounds and the composite character of the language itself have, in the course of several centuries of growth and continuous imitations, made of the alphabet a curious complex and complicated patchwork which is the despair of foreigners who attempt to learn the language. A technically perfect alphabet should have an alphabetic symbol to represent each sound in the language and no symbol should represent more than one sound. Were this the case all the difficulty in spelling would at once disappear. In Spanish schools spelling is not taught because of the regularity of the Spanish alphabet. In Italian also there is very little necessity for the teaching of spelling, for the same reason. But the irregularity of the English alphabet has placed a heavy burden upon the shoulders of elementary pupils and of foreigners learning the language. Years of study and practice are necessary to acquire a command of English spelling.

The modern English alphabet illustrates vividly the various changes through which the English tongue has passed since the days when the Germanic tribes first began to overrun the British islands. Saxon, Dane, Northman, Norman French, Celt and Latin have contributed to make it what it is to-day by giving it vowel and consonantal sounds and modifying those it primitively possessed when Saxon and Celt first met on English soil. The English alphabet has grown up without any attention being paid to its development or any effort being made to direct its development or to shape its ends. The result is that English has acquired a great many more alphabetic sounds than it possesses symbols with which to represent them. This, in itself, is bad enough, but the confusion is made all the greater by the fact that sometimes there are two or more symbols to represent the same sound, and that quite frequently compound letters are used to represent simple sounds. How complex, confused and confusing is English orthography may be illustrated by presenting the different garbs under which the sound *c* or *k*, as in cat or kit presents itself. It is represented by *cc* as in account; *cch.* in Bacchus; *ck.* as in back; *cq,* as in acquaint; *cu* as in biscuit; *lk,* as in talk, chalk; *lke,* as in Folkestone; *q,* as in queen; *qu,* as in liquor; *que,* as in barque, antique; *quh,* as in Urquhart; *sc,* as in viscount; *ugh,* as in hough; and *x,* as in excise, except; and finally by three combinations of the *k* symbol, *k,* as in kite; *ke,* as in Burke; *kh,* as in khan, making, in all, 19 letters and combinations of letters to represent the same sound. As if these various modes of representing the same simple sounds were not confusing enough, some of the combinations are used to represent other sounds. Thus *ugh,* in cough, represents *f; ch,* in schism is mute, while in schist it is sounded as *h. X,* in anxious has the force of *ksh,* and *ks,* in box. In Kale, Kaiser and words of Greek origin, *k* has the sound usually attributed to its name, and office which betrays its Greek origin (though it came into English from Latin, where it was also used almost altogether in the spelling of Greek words). Such irregularities as the foregoing are abundant in English spelling. The original cause of these irregularities, was prolific of a good crop of changes from the original Saxon forms of the English tongue. These were multiplied by the constant modifications produced by these various language sources acting and reacting upon one another, by the obscuring of full sounds and by the neglecting of others. These changes seem to have been many and to have taken place rapidly between the time of Chaucer and Shakespeare. The evidence of the cause of many of these changes is still to be seen in England and the Lowlands of Scotland to-day in the various rural dialects which sharply differentiate localities.

Printing and Spelling.— When printing was first introduced into Europe there was no standard of spelling, but attempts at spelling invariably conformed more or less to the sound of the word. As this sound was frequently quite different in different localities the attempts to represent it phonetically produced widely varying results. A similar result may be seen to-day in the conscious attempts of certain British writers to reproduce the Lowland Scotch, Yorkshire, Cumberland, Devonshire and other dialects and of American dialect writers to present graphically the manners of speaking English of the negro, the various foreigners in the country, the New England, Ohio, Western and Southern dialects. As there is no prescribed standard for the representation of these dialects so there is no uniformity of spelling employed by the different dialect writers. This condition represents well the lack of uniformity in spelling among writers of English previous to the introducing of spelling and even for some time afterward. But the multiplicity of books made possible by the invention of the printing press, the vast reduction in the cost of reproduction and the consequent spread of the printed word from the commercial centres made the imposition of some standard of spelling necessary. Unfortunately the imposition of this standard came at a time when the English language was still rapidly undergoing phonetic changes, and the standardized spelling made no provision for the modification of itself in conformity with the changes taking place. The Renaissance brought into the English language many foreign words, generally in their native dress, and these introduced new sounds and letters and combinations of letters, thus adding to the confusion, which became gradually greater as many of these foreign words, in the mouths of the illiterate, were modified in pronunciation while still preserving more or less closely their original spelling. In the course of time these various many-sided influences, syllables and sounds that were pronounced, at an earlier stage of the language, became mute; but still the rules of printing and custom engendered by them retained them. These attempts to promote a certain arbitrary uniformity and accuracy, while beneficial, contributed powerfully to the increase of the confusion already existing, by failing to provide for the recognition of signs becoming mute and of syllables and letters changing their phonetic value. This naturally continued to increase the ambiguity of the phonetic values of the letters of the alphabet and to augment the irregularities in their use. No longer the name or given value of a letter and its sounds in actual use corresponded. To such an extent has this confusion been carried that there is, at present, not a single letter in the English alphabet that does not represent two or more sound values. The vowels, being the actual voice sounds, are the most irregular in this respect. An analysis of these sounds is most suggestive of the confusion existing in English phonetics. Thus *o* has 10 sounds; *a*, *e*, and *u* have nine each; *i* has eight; while *y* has two as a vowel and three as a consonant. Were these sounds not duplicated they would represent 48 different vowels; but they are constantly replacing one another, thus making confusion more confounded to the foreigner who attempts to learn the English language. The confusion in the use of the consonants is great. One of them, *c*, has six sounds; four, *j*, *s*, *t* and *x*, have five sounds each; three, *d*, *g*, *z*, have four each; six, *f*, *h*, *l*, *m*, *n*, *q*, have three each; and the remaining seven have two each. The confusion in English orthography is still further increased by the presence of a great number of silent letters, some of which, however, serve to determine the value of other letters. There are but 44 sounds in the English language yet they are represented by about 500 symbols and combinations thereof with their various applications.

Phonetic Spelling.— Many attempts have been made at phonetic spelling, and the more scientific of these have come pretty near perfection, the failure to achieve perfection being due, in some cases, to a desire to achieve the practical over the purely scientific and phonetic. The best of these attempts have been made by the writers of methods of shorthand, one of the earliest and most satisfactory of which was that of Isaac Pitman (q.v.), which, with its derivatives, is the most widely used of shorthand systems. Pitman furnished an alphabet of 24 consonant and six long and six short vowel sounds, as follows: Consonants, p, b, t, d, ch, j, k, g (in *go*), f, v, th (in *thigh*), th in *thy*) s, z, sh, zh, m, n, ing, l, r, w, y, h; long vowels a (*ah*), a (*say*), e (*see*), a(*all*), o, oo; short vowels, a (*that*), e (*men*), i (*is*), o (*not*), u (*much*), u (good). For this purpose Pitman invented a series of new symbols quite distinct from those of the ordinary Roman alphabet, and he added a series of four diphthong symbols representing the sounds i, ow (*now*), oi (*boy*) and ou (*you*). These diphthong symbols and the *sh*, *zh* and the two *th* sounds are but duplications of sounds already expressed by other simple symbols in the Pitman alphabet. The work of Pitman and of some 200 workers in the field of shorthand together with many who have followed in his foot-steps has tended toward the simplification of English spelling to some small degree so far as the actual reforms accomplished. But the work is really greater than it appears, since the moral influence and the example of success attained of shorthand writers are already strongly thrown in the balance for radical and effective spelling reform, the demand for which growing slowly but nevertheless surely. See SHORTHAND; SPELLING REFORM; PHONETICS; INTERNATIONAL LANGUAGE.

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SPELLING REFORM, a systematic attempt to represent phonetically by letters in writing and print the accepted pronunciation of words. Such changes as have been made in any of the languages where the attempt has been made are of a purely tentative order. As was to be expected, in view of the power of the French Academy, the greatest advance towards a satisfactory and consistent spelling has been made in the French language, but there remains still much to be done before the written word is as indicative of the correct pronunication as is the case of Spanish and Italian. In Spanish, spelling is now absolutely phonetic, and Italian leaves little to be desired in this direction. In Germany the first moves toward improvement were made in 1880, the chief features of which were the omission of superfluous signs, the substitution of *f* for *ph*, the determination of the distinction between the hard and soft sounds of *s*, and changes of such nature. Changes in spelling have been continuous in the history of the English language, and conscious and deliberate efforts to simplify English spelling began at least as early as 1554. Dr. Johnson's 'Dictionary,' published in 1755, marked the beginning of the era of uniformity. Previous to this, people spelled as they pleased or as they could, sometimes using two or even more forms of the same word in the same paragraph. Shakespeare is known to have spelled his own name in 30 different ways, and other writers of the times previous and after 1755 were hampered by none, or very slight conventional rules, and were free to spell "like gentlemen," not like pedants. The attempt to reform English spelling, as previously noted, did not begin with Johnson; his work simply marked the place this reform had reached, and set up a common standard. The reform began very early (1554), and it is really no argument against the most advanced propositions to say we are getting away from the language of Shakespeare and the Bible, for if we compare the orthography of the Bible of 1611 with the Bible of to-day, with whose spellings there is no complaint, as many as 116 changes may be found in one chapter, Psalm cvi for instance. The greatest step forward toward a common-sense system was made by Webster in his 'American Dictionary' (1828), but much as his changes were decried, they were mostly those which had been recommended by others; as for instance, dropping the Norman French *u* (to which the English still cling with their inborn hatred of innovation) from *favour, honour, colour*, etc., changing the French *metre*, etc., to *meter;* omitting certain double consonants, and instead bringing the spelling of certain classes of words into a uniformity of style — thus making *mould* into *mold,* to agree with *gold,* which had been similarly treated, except in rural Ireland where it is still *goold* (*gould*). The Spelling Reform Association was formed at an international convention held in Philadelphia in 1876; the English association was established in 1879, and in 1884 certain changes were recommended for adoption by both associations as follows:

1. e.— Drop silent *e* when fonetically useless, as in *live vineyard, believe, bronze, single, engine, granite eaten, rained*, etc.
2. ea.— Drop *a* from *ea* having the sound of *e*, as in *feather, leather, jealous*, etc.
   Drop *e* from *ea* having the sound of *a*, as in *heart, hearken*, etc.
3. eau.— For *beauty* use the old *beuty.*
4. eo.— Drop *o* from *eo* having the sound of *e*, as in *jeopardy, leopard.*
   For *yeoman* write *yoman.*
5. i.— Drop *i* from *parliament.*
6. o.— For *o* having the sound of *u* in *but*, write *u*, in *above*, (*abuv*), *dozen, some* (sum), *tongue*, (tung), etc.
   For *women* restore *wimen.*
7. ou.— Drop *o* from *ou* having the sound of *u*, as in *journal, nourish, trouble, rough* (ruf), *tough* (tuf), and the like.
8. u.— Drop silent *u* after *g* before *a*, and in native English words, as *guarantee, guard, guess, guest, guild, guilt*, etc.
9. ue.— Drop final *ue* in *apologue, catalogue*, etc., *demagogue, pedagogue*, etc., *league, colleague, harangue, tongue*, (tung), etc.
10. y.— Spell *rhyme* rime.
11. Dubl consonants may be simplified.
    Final *b, d, g, n, r, t, f, l, z*, as in *ebb, add, egg, inn, purr, butt, bailiff, dull, buzz*, etc. (not *all, hall*).
    Medial before another consonant, as *battle, ripple, written* (writn), etc.
    Initial unaccented prefixes, and other unaccented syllables, as in *abbreviate, accuse, affair*, etc., *curvetting, traveller*, etc.
12. b.— Drop silent *b* in *bomb, crumb, debt, doubt, dumb, lamb, limb, numb, plumb, subtle, succumb, thumb.*
13. c.— Change *c* back to *s* in *cinder, expence, fierce, hence, once, peace, scarce, since, source, thence, tierce, whence.*
14. ch.— Drop the *h* of *ch* in *chamomile, choler, cholera, melancholy, school, stomach.*
    Change to *k ache* (ake), *anchor* (anker).
15. d.— Change *d* and *ed* final to *t* when so pronounced, as in *crossed* (crost), *looked* (lookt), etc., unless the *e* affects the preceding sound, as in *chafed, chanced.*
16. g.— Drop *g* in *feign, foreign, sovereign.*
17. gh.— Drop *h* in *aghast, burgh, ghost.*
    Drop *gh* in *haughty, though* (tho), *through* (*thru*).
    Change *gh* to *f* where it has that sound, as in *cough, enough, laughter, tough*, etc.
18. l.— Drop *l* in *could.*
19. p.— Drop *p* in *receipt.*
20. s.— Drop *s* in *aisle, demesne, island.*
    Change *s* to *z* in distinctive words, as in *abuse* verb, *house* verb, *rise* verb, etc.
21. sc.— Drop *c* in *scent, scythe* (sithe).
22. tch.— Drop *t* in *catch, pitch, witch*, etc.
23. w.— Drop *w* in *whole.*
24. ph.— Write *f* for *ph*, as in *philosophy, sphere*, etc.

After 1884 the subject of spelling reform did not attract any general attention for more than 20 years in spite of the publication of periodicals devoted to the propaganda, and the occasional outbreak of some enthusiastic votary, but in 1906 the establishment of the "Simplified Spelling Board" gave the reform a vigorous thrust forward. The board recommended for adoption a list of 300 "simplified spellings" with which to begin the change toward a more scientific literation of the language. This move would probably have attracted no more notice than many of its predecessors, had not President Roosevelt issued an executive order, in August 1906, directing the public printer to use all these spellings in the papers sent out by his office. The Congress, however, would not allow these changes to be made in the papers that came to the members from the printer, and in December the order was rescinded. The rather ill-advised exuberance of some of the advocates of the reform has made it an object of temporary ridicule, but the probabilities are that the really great advantages to be gained will be more and more appreciated, until the work of the reformers produces tangible and enduring results. The practice of isolated individuals may help, but real reform comes slowly and in accordance with reason and the laws of language. The Simplified Board claims that 380 institutions of higher learning and 456 newspapers and periodicals are now using most of the spellings recommended by the Board.

The character of the simplifications proposed is indicated by the following examples:

1. When *ed* final is pronounced *t*, write it simply *t*, where the change will not suggest an incorrect pronunciation, as *askt, fixt, wisht*, etc.; reducing a preceding double consonant to a single consonant, as *blest, kist, dipt, dropt, stept*, etc.; and changing *-ced* to *-st*, as *pronounst, rejoist, reverst*, etc.; but avoid misleading forms like *bakt* for *baked, deduct* or *dedust* for *deduced*, etc.
2. Change *ph* to *f* when so sounded as *alfabet, fonograf, fotograf, sulfur, telefone, telegraf*, etc.
3. Drop *e* final after *-lv* and *-rv*, as *delv, twelv, carv, serv, deserv*, etc.; also, in the endings *-ile, -ine, -ise, -ite, -ive*, unstressed pronounced *il, in, it, iv*, as *hostil, textil, anilin, determin, engin, examin, genuin, imagin, practis, promis, definit, favorit, infinit, opposit, activ, comparativ, nativ, positiv*, etc.; and at the end of *ar*(e), *hav*(e), *giv*(e), *forgiv*(e), *misgiv*(e), *liv*(e); because its normal use after a single consonant is to show that the preceding vowel is long. Hence it is retained in such words as *bare, brave, mile, fine, wise, polite, arrive.*
4. When the digraph *ea* is sounded as in *head* or as in *heart*, use the letter that is sounded and omit the other, as *helth, hevy, insted, tred, wether, plesant, hart, harth*, etc.
5. Substitute *e* for the digraphs and ligatures *ae, æ, oe, œ*, when not final, as *medieval, fenix, cyclopedia*, etc.
6. When *ch* is pronounced *c*, drop *h*, except before *e, i*, and *y*, as *caracter, epoc, arcangel, mecanic, monarc, scolar, scool, stomac, tecnical*, etc.; but *chemist, architect, monarchy*, etc.
7. Drop silent *h* from initial *rh*, as *rapsody, reumatism, rubarb*, etc.
8. Reduce *l'* final, after a short strest vowel, to *l*, as *bil, dol, dril, dwel, fil, ful, fulfil, shal, tel, wil, wilful*, etc.
9. Reduce the double final consonants *bb, dd, ff, gg, nn, rr, tt, zz*, to a single consonant, as *eb, ad, od, cuf, eg, bun, bur, whir, net, bus*, etc.
10. Drop *-me* from *mme* final, as *gram, program.*
11. Drop *-te* from *ette* final, as *cigaret, coquet, etiquet, omelet, quartet*, etc.
12. Drop silent *ue* final after *g*, as *catalog, colleag, dialog, pedagog, synagog*, etc.; except when *g* is preceded by a single long vowel, as in *rogue, vague, vogue*, etc. *Tongue* spell *tung*, Milton's way.
13. For *-ough* substitute *o, u, of, uf, ock, out*, or *up*, according to the sound, as *tho, thru, cof, enuf, hock, drout, hiccup*, etc. *Plough* spell *plow.*
14. Drop silent *b* final, as *crum, lam, lim, num, thum*, etc.; except where its omission would suggest an incorrect pronunciation, as *tomb, comb*, etc.
15. Drop *e* from *ey* final unstresst, pronounced like short *y* final, as *abby, barly, chimny, donky, gally, mony, trolly, vally, whisky*, etc.
16. Substitute *z* for *s* in the verb-suffix *-ise*, as *advertize, civilize, criticize, pauperize*, etc.
17. Change *re* final to *-er*, as *center, fiber, meter, theater*, etc.
18. Drop *u* from *our* final in words of two or more syllables, as *ardor, color, favor, honor, labor*, etc.

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SPELMAN, Sir **Henry,** English antiquary: b. Cougham, Norfolk, about 1562; d. London, 1641. He was graduated at Trinity College, Cambridge, 1583, and then attended Lincoln's Inn. He was a member of Parliament in 1597, high sheriff of Norfolk in 1604 and performed several public services for King James I. He was knighted in 1612 and retired to lifelong study, founding, in 1635. a short-lived Anglo-Saxon readership at Cambridge. His writings include ‘De non Temerandis Ecclesiis’ (1613); his colossal work, ‘Glossarium Archæologicum,’ of which he published volumes A to L (1626), the remainder being brought out by his son; and the material for his ‘History of Sacrilege,’ and his works on ‘The Councils of the Church’ and ‘The Tenures of Knight Service’ all of which were left incomplete and were posthumously issued.

SPELTER, *in commerce,* a name frequently applied to zinc, and to an impure zinc used in soldering. A mass of junked zinc articles, likely to contain impurities, is commonly classed as spelter.

SPENCE, spĕns, **Catharine Helen,** Australian novelist: b. Melrose, Scotland, 31 Oct. 1825; d. 3 April 1910. Her parents moved to Australia in 1839; and 20 years later she began working for electoral reform in behalf of which she lectured all over Australia and in the United States and Canada. She was a member of the Children's League from 1888 until her death and of numerous other bodies; and from 1878 onward she wrote extensively for the press. Most of her literary work appeared in *Fraser's Magazine, Cornhill, Harper's, Melbourne Review* and *Victoria Review.* For many years she worked as a journalist on the South Australia *Register;* and at the time of her death she was president of the Effective Voting League of South Australia and vice-president of the National Council of Women.

SPENCE, Francis Stephens, Canadian journalist and Prohibitionist: b. Donegal, Ireland, 29 March 1850. He went to Canada as a youth, and was educated at the Toronto Normal School. He was for a time engaged in teaching, but from 1882 was active as a journalist. He edited successively the *Canada Citizen, Vanguard,* the Ontario *Good Templar,* and was managing editor of the *Pioneer,* all publications of moral uplift tendency. He has been active in general organization work for Prohibition, and in 1886–1907 was secretary of the Ontario branch of the Dominion Prohibition Alliance. In 1911 he became president of the Ontario Municipal Association. Author of ‘The Facts in the Case’ (1896).

SPENCE, Henry Donald Maurice, English Anglican clergyman and author: b. London, 14 Jan. 1836. He was educated at Cambridge, took orders in the Established Church, and was professor of English literature at Saint David's College, Lampeter, Wales, 1865–70, and rector of Saint Mary de Crypt, Gloucester, 1870–77. He was principal of Gloucester Theological College, 1875–77, vicar of Saint Pancras, London, 1870–86, and dean of Gloucester from the last-named date. Among his many published books are ‘Dreamland and History’; ‘The Church of England: a History for the People’; ‘The White Robe of the Churches of the 11th Century’; ‘Christianity’; ‘Secrets of a Great Cathedral.’

SPENCER, spĕn'sėr, **Ambrose,** American jurist: b. Salisbury, Conn., 13 Dec. 1765; d. Lyons, N. Y., 13 March 1848. He was educated at Yale and Harvard universities and was graduated from the latter in 1783. He was admitted to the bar in Hudson, N. Y., where he was elected city clerk in 1786. In 1793 he represented Columbia County in the State legislature; in 1795 and for seven consecutive years was State senator; in 1804 became a justice of the Supreme Court, and in 1819 was promoted to be chief justice, which office he resigned in 1823, and resumed the practice of his profession at Albany. He was for some years mayor of that city, and also represented the Albany district in Congress. In 1844 he presided over the National Whig Convention at Baltimore. His energy, resolution and high legal attainments left a permanent impress on the constitution and institutions of New York.

SPENCER, Claudius Buchanan, American Methodist Episcopal clergyman and editor: b. Fowlerville, Mich., 20 Oct. 1856. He was graduated at the Northwestern University in 1881, and was ordained in the ministry in that year. He held pastorates in Michigan and Colorado in 1881–96; edited the *Rocky Mountain Christian Advocate* in 1892–1900; and since 1900 has edited the *Central Christian Advocate* at Kansas City, Mo. He is prominent as a Prohibitionist and in the general organization work of the Church. Author of ‘The Blue Flower of Methodism’ (1903); ‘The Layman’ (1912); ‘That They May be One’ (1915), etc.

SPENCER, George John, Earl, English politician and bibliophile: b. Wimbledon, Surrey, 1 Sept. 1758; d. Althorp, 10 Nov. 1834. He was educated at Harrow and Cambridge, and was elected member of Parliament for the county of Northampton. In 1783 he became the 2d Earl Spencer. In the House of Lords he voted with the Whigs till the period of the French Revolution, when, with some others of the party, he joined the party of Pitt. In 1794–1801 he was First Lord of the Admiralty and in 1806–07 was Secretary of State for the Home Department. Earl Spencer was president of the Roxburghe Club at its origination, and possessed the largest and richest private library in the world. The foundation of his library was laid in 1789, by the purchase of books in all parts of Europe. It was described by Dibden in 'Bibliotheca Spenceriana' (1814). The bulk of this library is now included in the Rylands Library, Manchester.

SPENCER, Herbert, philosopher and exponent of the modern philosophy of evolution: b. Derby, England, 27 April 1820; d. 8 Dec. 1903. His father was a teacher, a Non-Conformist, who was for years a Wesleyan, but who afterward seceded from that religious body and remained to the end of his life somewhat indifferent to outward religious forms, although a deeply religious man. The subsequent tendency of Spencer's philosophy was indirectly, but in a very potent way, determined by the education that his father gave him during his childhood and early youth. It was an education that decidedly tended to quicken his interest in the study of nature, and to develop his powers of independent thought and of inquiry into the nature of things. Furthermore, the Non-Conformist atmosphere in which Spencer grew up strongly tended to cultivate in his mind political liberalism of the type then characteristic of many of the most progressive English minds. In 1837 Spencer began the study of engineering under Mr. Charles Fox, the engineer of the London and Birmingham Railway, then recently constructed. Spencer continued his work in the service of the railway, with some interruptions, until 1841. In 1843 he went to London and engaged in contributing to the various periodicals, and in somewhat varied activities of a miscellaneous sort, until 1850. In 1842 he wrote a series of letters to *The Non-Conformist* — a newspaper then recently established as an organ of the Dissenters. The letters dealt with some principles relating to the influence of legislation upon social processes, and began the train of thought which Spencer later developed in his 'Social Statics.' The 'Social Statics,' his first book, was written between 1848 and 1850, and is characterized by the author himself as «a kind of natural history-ethics.» The work especially maintains the doctrine of the right of the individual, and of the necessity for non-interference on the part of the government. The characteristic of Spencer's sociological studies at this time, as contrasted with those of other English liberals who were his contemporaries, was the tendency to base the doctrine of non-interference upon very general considerations derived from natural history and from the study of natural law in general. Society, like the individual organism, is, so Spencer now teaches, the result of a growth, which is subject to determinate natural conditions, which in consequence tends on the whole to results advantageous, in the end, to individuals, while this growth of society cannot be safely interfered with by artificial devices. A generalization of the interests which Spencer thus early expressed led him within the next few years to a study of the processes of growth in nature in their more general aspects. Accepting, almost as soon as he distinctly conceived of it at all, the doctrine that all living forms are the result of natural processes of growth, and are not due to special creation, Spencer was led during the immediate following years to an effort to formulate in general terms the «law of progress,» or of development, which he conceived to be common to all such processes of growth. In 1854-55 he wrote the first edition of his 'Principles of Psychology,' in which he endeavored, first, to characterize in a decidedly novel way the nature and processes of life in general, and then to apply this general formula to the investigation of the development of mind. Life, Spencer now defines, as a series of changes occurring in an organism in such ways as involve «a continuous adjustment of inner relations to outer relations.» The mental processes are then defined as a special accompaniment and result of the adjustment in question. Between 1856 and 1860 Spencer, despite considerable interruption through ill health, published a large number of essays in various periodicals, among which the most important are: (1) the four papers which were later brought together in his volume on 'Education,' and (2) a number of essays tending toward the final expression of his general formula for evolution. As both bodily and mental development had now come, in Spencer's mind, to be conceived as subject to universal and common laws, he began to consider the possibility of a system of philosophy in which the general process of evolution should be stated in terms applicable to all kinds of development. The first sketch of this system of philosophy was outlined in 1858; and in 1860 the definitive program of the 'System of Synthetic Philosophy' was written out. The first edition of the 'First Principles,' which constituted the first part of this «system,» was prepared between 1860 and 1862, and was issued to subscribers in parts. The second part of the 'System of Synthetic Philosophy,' namely, the 'Principles of Biology,' was issued between 1862 and 1867. In 1867 Spencer recast and reissued his 'First Principles.' Between 1867 and 1870 he developed a new statement of his 'Principles of Psychology' as modified by the further development of his doctrine. The 'Psychology' in its new form was finished by 1872, and formed the third part of the system. The plan of Spencer's system required, next in order, the application of his principles to the study of sociology, an undertaking which proved to require a longer time than Spencer had originally contemplated. In 1872-73, at the instance of Spencer's American friend, Prof. E. L. Youmans, Spencer prepared, as an «extra book»— not a part of the system — a volume for the International Scientific Series, entitled 'The Study of Sociology.' In 1874 the first volume of the 'Principles of Sociology' began to be issued. For this work Spencer had been making, since 1867, and with the aid of secretaries, the elaborate collections of material which were, in a series of years, published under the title 'Descriptive Sociology.' After completing the first volume of the 'Principles of Sociology,' Spencer turned for the time to the beginning of what was to be the last division of his system, namely, ethics, and published, in 1879, the 'Data of Ethics.' The succeeding years, until the completion of Spencer's system in 1900, were principally devoted to the preparation of the second and third volumes of the 'Principles of Sociology,' and to the completion of the 'Ethics.' The 'Descriptive Sociology' continued to be issued until 1881 in parts. From time to time throughout the period of the preparation of the synthetic

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philosophy Spencer was interrupted for greater or shorter intervals by ill health. But he nevertheless found time to prepare and to publish a considerable number of essays of a controversial character, relating to his system and to its critics; to contribute also to various topics of current discussion; and his 'Autobiography,' published in 1904, is still another of the evidences of his extraordinary productiveness.

The complete list of Spencer's works, published during his lifetime, in the form which they finally assumed, in so far as he regarded them as worthy of permanent place among his productions, is as follows: First, the 'Synthetic Philosophy' itself, consisting of 'First Principles' (1 vol.); 'The Principles of Biology' (2 vols.); 'The Principles of Psychology' (2 vols.); 'The Principles of Sociology' (3 vols.); 'The Principles of Ethics' (2 vols.). Second, 'Essays: Scientific, Political and Speculative,' definitive edition (2 vols.). Third, 'Social Statics,' revised edition (1 vol). Fourth, 'The Study of Sociology' (1 vol.). Fifth, 'Education' (1 vol.). Sixth, 'Facts and Comments' (1 vol.). Seventh, 'Various Fragments' (1 vol.). Eighth, 'The Inadequacy of Natural Selection' (1 vol.). Ninth, 'Descriptive Sociology.' The last of these works is, in the main, a collection of material prepared by Spencer's assistants and printed as such, but under Spencer's direction.

In the most general outlines, what is characteristic of the philosophy of Spencer may be sketched as follows: In his theory of knowledge Spencer has many features in common with the classic English empiricism. But this empiricism, in his case, is modified by considerations due to the doctrine of evolution. Knowledge, namely, as he teaches, arises not merely through the experience of the individual, but through the experience of the race so that, in the individual, inherited intellectual tendencies determine the recognition of certain fundamental truths as certain and unquestionable so soon as attention is attracted to the matters which these truths express. Thus, mathematical certainties are based upon a kind of evidence which the individual finds to be absolute and unquestionable, but which the experience of the race has molded into their present forms. In consequence, when we inquire into the foundations of knowledge, we meet with certain assurances, which, in our individual cases, are to be tested by what Spencer calls the «universal postulate,» namely, «the inconceivability of the opposite.» That is whatever proposition is such that the experiment of trying to conceive its opposite to be true persistently fails is to be regarded as a primal necessity, and is to be accepted as true. If we ask how the human race came to know this proposition to be true, the answer is, through the inherited effects of experience. But if we ask why the individual must accept it as true, the answer is, simply because the opposite is inconceivable. Among the principles thus warranted by the «universal postulate,» the principle of the «persistence of force» is prominent. The fundamental principles of ethics have a similar foundation.

Since the ultimate source of our knowledge lies in the experience of the race, it is impossible either by individual observation or by means of the inherited effects of experience, to fathom the innermost nature of the real world. We can know only the world as it appears to beings with such an organization as the process of evolution has brought to pass in the case of our race. Any effort to transcend the limitations thus established leads into the region of what Spencer calls the «Unknowable.» Yet it would be wrong to endeavor to conceive our world as merely a world of phenomena, or of contents of experience, or to accept any form of idealism. For the test of the «inconceivability of the opposite» assures us, as one of the absolute certainties, that a world of genuine reality, transcending all our experience, both exists and is unknowable to us. It is equally impossible to deny (or rationally to doubt) the reality of such a world and to attempt any positive theory as to what its ultimate nature is. Subjective idealism, denying that the unknowable exists at all, is, therefore, according to Spencer, quite unthinkable. But every effort to give a positive account of ultimate reality breaks down by leading us to unavoidable contradictions, such as are involved in attempting to conceive the world in its wholeness, as either finite or infinite, as either caused or uncaused, as either absolute or relative, and so forth.

All such epistemological considerations, however, are for Spencer mere preliminaries. His principal philosophical interest lies on the positive side, namely, in the effort to reduce to unity the laws of the «knowable» world, that is, the laws which govern the phenomena of nature. Such a unification depends, first, upon recognizing the «persistence of force»—a term by means of which Spencer denotes the conservation of energy, as he conceives that fact. In practice, however, Spencer's term «persistence of force» is applied in more various ways than those which are customary in case of the usual doctrine of the conservation of energy. The «persistence of force,» used as a principle, guarantees us against accepting miracles, against conceiving anything as occurring counter to strict natural law, against accepting the doctrine of special creation, and so forth. In brief, the doctrine of the persistence of force gives us a view of what may be called the analytic unity of nature, namely, a view of that character which is common to every sort of natural process.

If, however, we turn from the consideration of this most universal aspect of nature to a study of the various types of natural processes which are observable when we consider large masses, or series of natural phenomena, we come hereupon to the principles characteristic of what may be called the synthetic unity of nature, that is, of that unity which appears when we consider the entire lives of organisms, or the histories of races of living creatures, or the history of planets, of solar systems or, in another realm, of societies. These processes which the persistence of force render possible are of two general types. They are, namely, either processes of evolution or processes of dissolution. Evolution occurs when great aggregations, such as have just been mentioned, appear and grow and become organized. The formation of a stellar system, the solidification of a planet, the gradual building up and diversification of the earth's crust, the growth of a race of animals or of plants, the life history of an individual or of a nation — these are processes of evolution. Dissolution is the reverse of any of these processes. When an aggregate is distintegrated, dissolved or otherwise destroyed, when an organization passes away or disappears, we are, therefore, dealing with dissolution.

Evolution is of course the more interesting of these two processes. It possesses, according to Spencer, two characteristic forms, primary evolution and secondary evolution — the latter being based upon the former, but occurring in less frequent instances, although these instances are very highly interesting and important. The characteristic of the primary evolutions is that they involve «an integration of matter and a dissipation of motion.» Such processes occur when masses of matter cool, contract and solidify — as, for instance, when planets are formed. The processes of secondary evolution are rendered possible by the fact that some of the bodies subject to primary evolution do not merely contract and solidify, but also pass through a stage or a series of stages of their existence, in which they predominantly possess a «plastic» character. «Plastic bodies» are such as are sufficiently free from a close coherence of parts to permit of easy change in consequence of change in their environment, while at the same time these plastic bodies are sufficiently coherent to retain the traces of disturbances which have happened to them. Thus, a mountain range, subject to erosion, not only yields in numerous ways to the action of water and of weather, but retains, in a great variety of ways, the traces of such erosions as have occurred in the past, instead of being swept away at once by a single flood, as a smaller mass might be. Again, a living organism is a plastic body, so full of internal motion, or of stored-up energy, as to be greatly and easily disturbed by its environment, while at the same time it is so far possessed of rigidity in its structure and in its way of responding to external influences, that traces of what has happened to it remain, in great variety, and for a long time, or even throughout the life of the organism. The power of an organism to adjust itself to new conditions, in combination with the power to form and retain habits, constitutes the basis for all the higher development of life. All such powers depend physically upon the characteristics of the «plastic bodies,» and the process of organic evolution is altogether to be described as due to the accumulation of such secondary evolution as these properties of plastic organisms make possible. Since the brain itself, such as any higher animal possesses, is a plastic body, the result of processes of aggregation, and is itself on the way toward a greater solidification (such as occurs in old age), while the brain, during youth and early maturity, is at once extremely sensitive to disturbances and very apt to retain the results of former disturbance — it follows that the entire evolution of the mind, which so far as the mind is knowable, accompanies the development of the brain, is itself to be described in terms of the properties of the plastic bodies.

In consequence of the fact that evolution, so far as it is a process of the knowable world, is thus a result of «the integration of matter and the dissipation of motion,» and, in case of the secondary evolutions, is a result of the formation of the plastic bodies, it follows that all evolutionary processes must possess certain common features. The primary evolution, otherwise called «simple evolution,» consists altogether of the formation of «coherent aggregates,» such as result whenever bodies solidify and part with their internal energies. The secondary evolution, also called «compound,» includes changes that are due to «differences in the circumstances in the different parts of the aggregate.» The most notable result of these internal differences is a «transformation of the homogeneous into the heterogeneous.» Wherever evolution takes place in a plastic body such increasing differentiation is inevitable, the reason being that the traces of previous changes are retained, and are made the basis of increasing variety, as the traces of new changes are superposed. In the more complex instances of secondary evolution the transition from the homogeneous to the heterogeneous is long continued and extremely complicated. It is exhibited not only in the structure of an aggregate, but in the functions which belong to this aggregate, in case the aggregate is, like a living organism, the seat of a great variety of energies. The increasing complication and differentiation of the functions and habits of a living organism is thus the result of the same kind of process as makes its appearance even in inorganic nature wherever the results of former changes accumulate in a plastic body. Wherever integration and increasing heterogeneity are long continued and important, they are also accompanied by an increasing definiteness of structure and function, which Spencer describes as due to the process called by him «segregation.» Segregation is exemplified wherever the outlines of things grow sharper, wherever the like things of the natural world tend to be grouped near together or the unlike things to be kept apart. For certain natural forces, whose presence in the world Spencer extensively illustrates, are working along with whatever tends to differentiate phenomena and are so working as to tend to sort out, or to segregate, like and unlike things. Such forces are manifest in the case of the formation of geological strata through sedimentary deposits, and in the case of the grouping together of similar organisms in societies, and in large numbers of other instances. Segregation combines with differentiation, and with integration, to characterize the whole evolutionary process.

As has just been suggested, Spencer also applies these principles to explain the laws of social structure and function and to describe the evolution of society, and his especial interest in all these considerations lies in his attempting to make clear the unity of the evolutionary processes, whether organic or inorganic.

The application of the evolutionary formula to the study of psychology has already been in general indicated. Mental functions grow in a way that is precisely parallel to the growth of certain organic structures and functions. Consequently integration, differentiation and segregation can be traced in mental life as well as in organic life. And in so far as the conditions of mental life are knowable at all, these conditions have to be defined in the terms of the same evolutionary formula which apply to plastic bodies in general, that is, to their structure and to their functions. In order to apply these considerations to that study of ethical problems which so early interested him and to the defense of those social doctrines which he so early emphasized, Spencer laid especial stress upon naturalism in ethics, that is, upon the necessity of consulting the natural conditions of organic life in order to define the norms of conduct. Conduct is an evolutionary phenomenon and is to be considered in the light of the general formula for evolution. Conduct, for instance, is a part of the adjustment of the organism to its environment and is to be judged in the light of the laws of that adjustment. That conduct which secures the most perfect adjustment is at once the most acceptable to society, and, by virtue of the conditions under which mind has developed, is in the long run most satisfactory to the individual concerned. For in case of the human organism, the adjustment of internal to external conditions normally occurs in society. Hence such adjustment as keeps the individual in harmony with his social order is conduct of the type favored by evolution. The inherited effects of experience appear in those of our instincts which fit us for harmonious social life. On the other hand, social harmony does not mean social subordination. The goal of social development is a condition of equilibrium in which the individual is as little interfered with by his society as possible, in so far, namely, as interference would involve coercion or restraint. Meanwhile, as this goal is approached, the individual grows increasingly differentiated in his social functions, better adapted to a wider and wider range of social conditions and more definite in his functions.

Notable in Spencer's work has been his attitude toward the problems of past and of contemporaneous religions. The religions of the world are the results of evolutionary processes whose knowable aspect Spencer elaborately discusses in his 'Sociology.' Viewed as to their contents, they have always included efforts to transcend the bounds of human experience, in a word, to transcend the knowable. But in recognizing the existence of an unknowable, the synthetic philosophy, as Spencer maintains, has itself, in a measure, justified one of the deepest religious interests, namely, the interest of finding ourselves in some sort of relation to a power which, inscrutable though it may be, is still ever-present and is the source of all things.

In his 'Essays on Education' Spencer has made prominent the importance of the study of natural science and has emphasized the significance of the sort of training which he himself originally received from his father.

In sum, Spencer was one of the leaders of the age in which the modern doctrine of evolution came into prominence. In his own development he was, until 1860, when he first became acquainted with Darwin, substantially independent of other evolutionary thinkers, at least among his contemporaries. Indirectly and somewhat unconsciously, he was influenced (as Prof. John Dewey has pointed out) by the tradition of 18th century French philosophy; consciously he was molded by the English liberalism of his time; and less prominently he was affected by the Kantian epistemology, with its limitation of human knowledge to the phenomenal world. The Kantian influence was indirect, occurring through Spencer's reading of Hamilton and of Mansel. Spencer's popular influence has been very large — still larger in America than in England. His most notable undertaking is the effort to formulate the doctrine of evolution in general terms; as a part of the undertaking, his work in psychology, in sociology and, to a less degree, in educational theory and in ethics, has proved widely influential. Consult Elliott, H., 'Herbert Spencer' (New York 1916); Hudson, W. H., 'Introduction of the Philosophy of Herbert Spencer' (New York 1894); Collins, F. H., 'Epitome of the Synthetic Philosophy' (New York 1901); Royce, J., 'Herbert Spencer: an Estimate and Review' (New York 1904 containing also personal reminiscences by James Collier).

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SPENCER, Jesse Ames, Protestant Episcopal clergyman, author and educator: b. Hyde Park, N. Y., 17 June 1816; d. Passaic, N. J., 2 Sept. 1898. Having graduated from Columbia University and completed in 1840 a course in theology at the General Theological Seminary, he entered the ministry, becoming rector of Saint James Church, Goshen, N. Y., where he remained for two years. Later, he became professor of Latin and Oriental languages at Burlington College, 1849–50; accepted the position of editor and secretary of the Episcopal Sunday School Union and Church Book Society, serving from 1851–57; for two years, 1863–65, was rector of Saint Paul's Church, Flatbush, L. I., and from 1869–79 was Greek professor in the College of the City of New York and professor emeritus, 1879–81. His most important books were 'History of the English Reformation' (1846); 'History of the United States' (1856–69); 'Sketch of the History of the Protestant Episcopal Church in the United States' (1878); 'Memorabilia: Recollections of Sixty Years, 1826–86' (1890), etc. He also edited six volumes of Arnold's series of Greek and Latin textbooks (1846–50), etc. In 1883 the House of Bishops appointed him custodian of the Standard Bible.

SPENCER, John Canfield, American lawyer, son of Ambrose Spencer (q.v.): b. Hudson, N. Y., 8 Jan. 1788; d. Albany, N. Y., 18 May 1855. He was graduated from Union College in 1806, was private secretary to Governor Tompkins in 1807–09 and in the latter year was admitted to the bar. In 1811 he became master in chancery, was appointed judge-advocate-general on the northern frontier in 1813 and assistant attorney-general of New York in 1815. He served in Congress in 1817–19, was a member of the State assembly in 1819–20, acting as speaker in the latter year, and in 1824–28 he was State senator. He was one of the commissioners to revise the statutes of the State of New York and was special attorney-general in the prosecution of the Masonic murder of William Morgan (q.v.). In 1839–41 he was Secretary of State and Superintendent of common schools and in the last-named year was appointed Secretary of War by President Tyler. He was transferred to the Treasury Department in 1843, but resigned in the following year because of his disapproval of the annexation of Texas. He thereupon resumed his law practice, was afterward a member of various State commissions, was actively instrumental in introducing an improved common school system, and the organization of the State asylum for idiots was due largely to his efforts. He edited, with preface and notes, Henry Reeve's translation of Tocqueville's ‘Democracy in America’ (2 vols., 1838), and was joint author of ‘Revision of the Statutes of New York’ (3 vols., 1846). Consult Proctor, ‘Review of John C. Spencer's Legal and Political Career’ (1886).

SPENCER, Joseph, American soldier: b. East Haddam, Conn., 1714; d. there, 13 Jan. 1789. He entered the Northern army in 1758, rose to the rank of colonel and in 1775, at the suggestion of Washington, was appointed brigadier-general by Congress He took umbrage at the promotion of Gen. Israel Putnam and was about to withdraw from the army but decided to remain and served around Boston until its evacuation. He was then transferred to the defense of New York, promoted major-general in 1776 and in 1778 he was placed in command in Rhode Island. He assembled his forces at Providence, and instituted a movement against the British at Newport which failed, resulting in his censure and retirement.

SPENCER, Joseph William Winthrop, American geologist: b. Dundas, Canada, 26 March 1851. After graduating from McGill University, Montreal, in 1874, where he took first honors in geology and mineralogy, he studied at the University of Göttingen, Germany, whence he was graduated Ph.D., in 1877. In 1877 he was appointed science master at the Collegiate Institute at Hamilton, Ontario; in 1880 became vice-president and professor of geology in King's College, Nova Scotia; in 1882 accepted the chair of geology in the University of Missouri, remaining there till 1887; and was State geologist of Georgia from 1888–93. He designed the museum building for the University of Missouri and procured many of the specimens for the geological department. In 1893, having come to New York, he became dissatisfied with the technical publications of the experimental stations and induced the legislature to appropriate $8,000 for university extension of agriculture, the money being placed with Cornell University, part for carrying the Agricultural College to the farmer and part for the Experimental Station. In 1896 he was placed in charge of the department for a farmers' correspondence reading course and later, with the aid of the Department of Public Instruction, succeeded in introducing agriculture under the name of «nature study» into the public schools. In 1905–08 he was special commissioner of the Geological Survey of Canada. He has made extended investigations of glacial geology of the Great Lakes region and Niagara Falls and of the geologic history of the Antilles and Central America. His report on ‘The Falls of Niagara’ (1907), in which the age of the falls is stated to be 39,000 years plus or minus 4,000 years, was issued by the Canadian Geological Survey. He has written ‘Niagara, Fossils’ (1884); ‘Glacial Erosion in Norway’ (1887); ‘Geological Survey of Southwestern Georgia’ (1891); ‘Geological Survey of the Paleozoic Belt of Georgia’ (1893); ‘Origin of Niagara Falls and History of the Great Lakes’ (1895); and many papers in scientific journals, relating to the same subjects.

SPENCER, Platt Roger, American penman: b. East Fishkill, N. Y., 7 Nov. 1800; d. Geneva, Ohio, 16 May 1864. At 15 he taught his first writing class; and from 1816–21 was employed as a bookkeeper. He then studied law and later became a teacher in the common schools. He was instrumental in the establishment of business colleges throughout the United States, and published ‘Spencer and Rice's System of Business and Ladies' Penmanship’; ‘Spencerian or Semi-Angular Penmanship.’ What is known as Spencerian penmanship derives its name from him as its exponent.

SPENCER, Sara Andrews, American social reformer: b. Savona, Steuben County, N. Y., 21 Oct. 1837; d. 1909. She was graduated from the Saint Louis Normal School, 1856, and was married to H. C. Spencer in 1864. Having removed to Washington she with 72 other women attempted to register and vote in 1871 but was refused. She then brought suit which resulted in decisions of the Supreme Court of the District of Columbia and the Supreme Court of the United States that women could not vote without local enabling legislation. She was instrumental in the passage of a bill in the District of Columbia, 1873, for the rescue of outcast girls, and was secretary of the National Woman Suffrage Association 1874–81, and president of the Woman Franchise Association of the District of Columbia, 1871–76. She has published ‘Problems of the Woman Question’: ‘Thirty Lessons in the English Language.’

SPENCER, Sir Walter Baldwin, professor of history at the University of Melbourne: b. Stratford, England, 1860. He was graduated from Oxford and became professor of biology in the University of Melbourne in 1887 and director of the National Museum of Natural History, Geology and Ethnology. He was a member of the Horn Scientific Expedition to central Australia in 1894 and editor of its reports. With F. I. Gillen, he conducted an ethnological expedition across Australia to the Gulf of Carpentaria in 1902. He was knighted in 1904. He is joint author with Gillen of ‘The Native Tribes of Central Australia’; and also of ‘Northern Tribes of Central Australia’; and author of ‘Pincal Eye in Lacertilia’; ‘The Narrative of the Horn Expedition’; ‘Across Australia’ (1902); ‘Native Tribes of the Northern Territories of Australia’ (1914).

SPENCER, Iowa, city, county-seat of Clay County, on the Little Sioux River, and on the Chicago, Milwaukee and Saint Paul Railroad, 75 miles northwest of Fort Dodge and 80 miles northeast of Sioux City. It is in an agricultural and stock-raising region. Its chief industries are connected with farm and dairy products. It is a railway junction and local commercial centre. It makes large shipments of corn, wheat, livestock, vegetables and dairy products. There are public elementary schools, a high school, a private commercial school, a library, banks and newspapers. Pop. about 3,005.

SPENCER, Mass., town, one of the county-seats of Worcester County, on the Boston and Albany Railroad, about 12 miles west of Worcester. It is in a beautiful region, about 1,000 feet above sea-level and surrounded by farm lands. It was settled in 1717 by Nathaniel Wood. Originally it was a part of Leicester, and in 1744 it was made the West Parish of Leicester, and in 1753 was incorporated as a town with the name of Spencer. In 1744 its first church was organized. It is the birthplace of Elias Howe (q.v.), inventor of the sewing machine. It has a large shoe factory, woolen mills, vinegar works and wire works. There are seven churches, the David Prouty high school, public and parish elementary schools, and the Richard Sugden Public Library, opened in 1857. There are several banks and newspapers. The government is administered by a board of five selectmen. Pop. about 6,740.

SPENCER GOLF, Australia, a large inlet of the Indian Ocean indenting the south coast of South Australia between Eyre and Yorke Peninsula. Sixty miles wide at the entrance, it widens to nearly 100 miles, and then narrows gradually into a fiord at Fort Augusta, nearly 200 miles inland.

SPENER, spā'nėr, **Philipp Jakob**, German clergyman, "the father of Pietism": b. Rappoltsweiler, upper Alsace, 13 Jan. 1635; d. Berlin, 5 Feb. 1705. Although called the founder of Pietism (q.v.), which resulted in a salutary reformation within the Lutheran State Church, none of the errors or extravagances which marked the development of the movement can be attributed to Spener. His early training revealed to him the necessity of a moral and religious reformation of the German Church and with a view to the ministry he studied practical Christianity at Strassburg, specialized in philology, history and philosophy, gained his degree of master in 1653, spent a year in Geneva where he was powerfully influenced by Leger and Labadie, studied also at Basel, Tübingen and Lyons, and in 1666 became a pastor at Frankfort-on-the-Main. Pietism developed from meetings at his house at which his sermons were discussed and the Scriptures were expounded. In 1675 he published his 'Pia Desideria, oder herzliches Verlangen nach gottgefälliger Besserung der wahren evangelischen Kirche' or 'Earnest Desires for a Reform of the True Evangelical Church.' It embodied proposals for the restoration of life in the church, chief of which were the serious study of the Scriptures in private meetings, *ecclesiola in ecclesia*, a smaller church within a church — a heart of spirituality; the universality of the Christian priesthood, the laity sharing in the spiritual government of the church; and regeneration or the promotion of personal piety instead of the inculcation of dogmatic beliefs. The work created a deep impression throughout Germany and much offense among orthodox clergymen, the more so that its premises were undeniable. The 'Pia Desideria' was followed in 1680 by 'Allgemeine Gottes-gelehrtheit.' In 1686 he was appointed first court chaplain at Dresden, but soon offended his patron Elector John George III by his outspoken and uncompromising attitude in the fulfilment of his duties. His criticisms of the immorality of the wealthy classes had previously given offense, but in 1691 the court of Brandenburg was influenced to offer him a rectorship and he became 'Konsistorialrat' of Saint Nicholas in Berlin. In a court and government more inclined to rationalism than pietism Spener, however, was held in esteem and along lines advocated by him the university of Halle was founded in 1694 and became the centre whence pietism spread. He was a voluminous writer and the movement which he originated owing to the extremes to which some of his followers went was constantly attacked and abused by the orthodox. The theological faculty of Wittenberg in 1695 condemned as errors 264 propositions contained in his writings. Three years before his death he completed 'Theologische Bedenken' (4 vols., 1700–02). 'Letze Theologische Bedenken' appeared posthumously with a biographical introduction by C. H. von Canstein (1711). Consult Gruneberg, P., 'P. J. Spener' (3 vols., Göttingen 1893–1906); Hossbach, W., 'Philipp Jakob Spener und seine Zeit' (Berlin 1828; 3d ed. 1861).

SPENLOVE-SPENLOVE, Frank, English painter: b. Sterling, Scotland, 1866. At the Paris Salon his 'Funérailles dans les Pays Bas' was awarded the gold medal of Paris and purchased for the Luxembourg (1901). He exhibited at the Royal Academy for the first time in 1886 and has been represented there every year since. Among his landscapes and genres may be mentioned 'After Summer Days'; 'Night's Awakening'; 'Gilded Pastures'; 'Over the Valley' 'Avenues of Gold'; 'Picardy'; 'The Hurrying Storm'; 'A Winter's Tale — Funeral Blessings, Holland'; 'Unto This Last — The Pilot's Funeral'; 'Too Late'; 'Darsham Vale'; 'Autumn Glory'; 'The Little White Cross'; 'Grey of the Morn'; 'In the Shadow of the Church', etc.

SPENSER, Edmund, English poet: b. London (probably in East Smithfield near the Tower), about 1552; d. Westminster, 16 Jan. 1599. He was the eldest son of Elizabeth (cf. 'Amoretti,' LXXIV) and (perhaps) John Spenser, "free journeyman" in the "arte or mysterie of clothmakynge," in 1566 with one Nicholas Peele, "sheerman" in Bow Lane. A "John Spenser, son of John Spenser, gent.," known to have followed the poet through the same school and college, may have been a younger brother. In the Burnley district of N. E. Lancashire there was a family of Spensers, among whom the names John, Edmund, Lawrence were common. The poet had a son Lawrence. Edmund also shared in the benefactions of Dean Nowell, relative by marriage of the Lancashire Spensers.

This commonplace upcountry stock hardly invited celebration from the ambitious Court poet; but *the* Spencers of Althorpe, Northamptonshire, were a kinsfolk to be claimed and proclaimed. And, after 1590 at least, three daughters of Sir John Spencer, head of that "house of auncient fame," acknowledged and patronized their now famous, if still impecunious connection; he in return is profuse with dedication and complimentary allusion. To one, Elizabeth, Lady Carey, he writes, dedicating ‘Muiopotmos’: «. . . . I have determined to give myself wholy to you, as quite abandoned from myselfe, and absolutely vowed to your services.» No doubt solely on the strength of this «platonic» vow, Nashe two years later (1593) assured Lady Carey in his dedication of ‘Christs Tears over Jerusalem’ that «Fame's eldest favorite, Maister Spenser, in all his writings he prizeth you.»

To his father's association with the Merchant Taylors' Company, and to Dean Nowell's help, Spenser apparently owed an excellent education. The recently (1561) founded Merchant Taylors' School offered free tuition to 100 poor boys and the «free journeyman's» son was doubtless one of these. Later, at Pembroke College, Cambridge, he matriculated 20 May 1569 as a «sizar,» or student who for certain services was exempted from fees and given board and clothing. Moreover, Dean Nowell's accounts (ed. Grosart, 1877) show several gifts of money from 1569 on; and already in 1569 Spenser was earning money himself. At least, certain sonnets included by Ponsonby in the ‘Complaints’ of 1591 are manifest revisions from a certain ‘Theatre for Worldlings’ of 1569. This was an English translation of a Protestant polemical miscellany by a Flemish refugee physician, John Vander Noodt, resident at Christ Church school, and very likely known to Mulcaster, master of Merchant Taylors' School. Mulcaster's boys were especially trained in Italian and French and young Spenser may well have been recommended to Vander Noodt for the place. Moreover, Spenser was almost certainly behind Ponsonby in the publication of the ‘Complaints’; and abundant internal evidence makes for the authenticity of the translated sonnets. These are from the ‘Songe’ added to DuBellay's ‘Antiquitez du Rome,’ and Marot's version in sonnets of Petrarch's *canzone* «Standomi un giorno, solo, alla fenestra.’ They illustrate interestingly the early maturing of the poet's elegiac Puritanism, stately archaic diction, and flexible verse. Though rhymed for the ‘Complaints,’ the Bellay «sonnets» of 1569 are in a blank verse better modulated than any other between Surrey and Marlowe.

Spenser took his B.A. at Cambridge 1573; M.A. 1576. Allowances for protracted illnesses indicate delicate health; but he was clearly an eager, if discursive, student. Following Mulcaster's lead, he read widely Italian and French literature as well as classic, the older English authors — especially Chaucer and Langland, moral and natural philosophy — especially the hybrid Platonism of the period. Harvey's nicknames for him — «Italianate Seignor,» «Your French Monsieurship,» etc. — recognize his cosmopolitan tastes. Training and temperament made him sharply partisan for the Puritans, whose leader in the University, Cartwright, was driven from his chair of divinity in 1570.

The young master of arts probably did not seek a fellowship. Had he failed, his friend Harvey was not the man to have kept silence. More poet than scholar, Spenser doubtless, like other needy Elizabethan poets, looked to place and patron and became first, it would seem, tutor or secretary in the family of a lady of rank in the «North partes» of England; and was then, upwards of a year later, called by Harvey to Kent «for his more preferment.»

This «Gentlewoman of no meane house» in the «North partes» is the «Rosalinde» of the ‘Shepheards Calendar’; and the poet's pretense of blighted passion implies probably no more than regulation «loving» gratitude to lady-patron. He was, as she put it, «her Seignor Pegaso.» Twelve years later, in ‘Colin Clouts Come Home Againe,’ he defends her against the charge of disloyal cruelty by pretty clear intimation that his «passion» had been but «Platonic» tribute.

The editor of the ‘Calendar’ says that the name «Rosalinde» «being wel ordered, wil bewray the very name of hys love and mistresse»; and the hint may have enlightened a select few. But the possible anagrams — if anagram is meant — of «Rosalinde» are many; and the «feigned name» seems too good to be a strict anagram. Solutions have been numerous, but unconvincing. That she was a Lancashire «lasse» met by the young graduate on a visit to his relatives there, seems unlikely: an ambitious youth would hardly seek preferment among small farmers in a remote rural corner of England. The asserted Lancashire setting and dialect of the ‘Shepheards Calendar’ are uncritical myths: setting and language are not local, but literary and composite, artificial rustic («Doric») and conventional «Arcadian.» Moreover, there is Aubrey's statement, on the asserted authority of John Dryden, that «Rosalinde» was a «kinswoman» of Sir Erasmus Dryden's wife, who was a daughter of William Wilkes of Hodnell, Warwickshire, a place not far from the Cotswold Hills. Whatever difficulties may lie in calling these hills «North partes,» at least Drayton, in one of his eclogues, set «Rosalinde» there.

From these «North partes» Spenser was called to become «the Southerne shepheardes boye» in Kent. Through the «shepheard,» acceptedly Sir Philip Sidney, he may presently have been made secretary to Sir Henry Sidney, Lord-Deputy in Ireland. At least, in the ‘Veue of the Present State of Ireland’ (Globe ed., p. 636), Irenæus, Spenser's general mouthpiece, professes to have witnessed the execution of «Murrogh O-Brein,» 1 July 1577.

Two years later, 5 Oct. 1579, Spenser appears in the service of Sir Henry's brother-in-law, Leicester, and writing to Harvey from Leicester House. This letter and another, with Harvey's answers, were published, presumably by Harvey, a year later. They reveal 1579–80 as the poet's *annus mirabilis*. Brimful of publishing projects, eager for literary reforms, received at Court, had «in some use of familiarity» by such high society as Sidney and Dyer and by pretty women (to sober Harvey's alarm),— before the year-end he had achieved the program of a new poetic school, written its manifesto and outlined his own chief works to come. Among other projects, he informs his somewhat sceptical friend of a great Continental trip on Leicester's business. Then suddenly, as it seems, all this stops. He arrives in Dublin, 12 Aug. 1580, secretary to the new Lord-Deputy, Lord Grey de Wilton.

Meanwhile, but one of his several finished poems had been printed; and this under a pseudonym and ostensibly on a friend's responsibility. The 'Shepheards Calendar,' finished before 10 April 1579 — date of the editor's epistle to Harvey,— but not «entered» until December 5, appeared soon afterward, embedded in a literary apparatus full of mystifications. Secrecy, however open, was in the «amorist» code. More importantly, the «theological» eclogues expressed opinions close to treasonable and preferred unpleasant personal charges. The editor, «E. K.,» played his part well, being at times clairvoyant of the author's secret meanings, at other times obtuse as «Ignaro» himself. He was doubtless Edward Kirke, once with Spenser at Pembroke College; but much of the «glosse» must have been inspired, if not dictated, by Spenser himself, who, if perhaps «furre estraunged» in April, was certainly in London in October 1579.

The 'Shepheards Calendar'— perhaps so-called from a popular almanac, the 'Kalender of Shepherdes'— contains, as its sub-title indicates, «twelve aeglogues proportionable to the twelve monethes.» It was dedicated to Sir Philip Sidney. The «aeglogues» are of the Renaissance courtly type, in no proper sense poems of country life. The nature described is «Arcadian»; the description decorative; the real appeal personal and polemical. Tribute to a past patron, «Rosalinde,»— to a present patron, Leicester, in the dirge for his kinswoman, «Dido,»— to a hoped-for patron, the Queen, in the «laye of Elisa»; partisan support of Leicester's Puritanism against Burghley's «Anglicanism»; proclamation of his own Platonist poetics — such are the live interests; the rest, as E. K. says, is «recreative,» little neo-classic idyls in porcelain. Such «pastoralism» is a poetry, not of nature, but of art,— goldsmith's art for nicety and «curious felicity» of detail. The 'Calendar' is the first English poem which rivals the poetic virtuosity of Renaissance Italy and France.

But «Immerito» justifies his editor's title of the «new Poet» in a larger sense. He appears in the 'Calendar,' like his master Du Bellay in the 'Deffence et Illustration de la Langue Francoyse,' as the spokesman of a school of «new poets»— Sidney, Dyer, Fulke Greville and perhaps others — who form an «Areopagus,» in emulation of the «Pleiade,» to promulgate in England the tenets of Du Bellay's and Ronsard's poetic reform. The poet is to be «defended» as an inspired teacher, born not made, but needing «laboure and learning» fitly to understand and to express his high message. By him the common speech must be «ennobled» (*illustrée*) by art into a really «poetic diction,» — inversely to Wordsworth's contention. The new poet's method is to be «assimilative imitation» of the classics primarily, but with a judicious eye to the best among modern and national models. Spenser's own pronouncement, 'The English Poete,' was not printed; Sidney may have worked it into his own 'Defense of Poesie,' the Platonist doctrine of which concurs with Spenser's. The question of «classical» metres was discussed by the «Areopagus,» as it had been by the «Pleiade»; but the Harvey-Spenser correspondence has exaggerated its importance for the English school.

Spenser aspired early to be the English «Virgil»— the «*poeta novus*» of his own day — and in 1579 had already begun the epic designed to follow his «low-flying» pastoral as the 'Æneid' followed the 'Bucolica.' Such indeed was, as E. K. says, the common aspiration of Renaissance poets. Du Bellay eloquently demanded for France a «*long poëme*» worthy to stand with the 'Æneid' and the 'Orlando Furioso.' For the Renaissance, however, Virgil was more than the poetic historian of the founding of Rome — the «*romanus Vergilius*» of Petronius; he was also the moral allegorist of Macrobius and Petrarch, and the unwitting Christian prophet of Dante. Spenser's first idea was, apparently, to re-express these patriotic, moral and religious motifs in the style of the 'Orlando Furioso,'— thus satisfying the eclectic ideal of the new school. In 1579 he sent Harvey a draft of his resulting 'Faerie Queene.' But Harvey was unconvinced by this attempt to «overgo» Ariosto; and Spenser worked away in silence for 10 years. Of the 'Faerie Queene' of 1590 Harvey was loud in praise; and in fairness, we may presume a radical recasting.

Until Lord Grey's retirement, August 1582, Spenser was his secretary. By March 1581, he had also purchased from Ludowick Bryskett appointment, with right of deputy, as registrar or clerk of the Faculties of the Court of Chancery in Dublin. He began, too, a series of land-speculation,— first buying, to sell immediately Abbey Enniscorthy in County Wexford, and an abbey in New Ross. Next, January 1582, he leased for six years the Dublin residence of the attainted Lord Baltinglass, and secured a «custodian» of Newlands in Kildare, property of a relative of Baltinglass. On August 24 he leased for 60*s*. a year «the dissolved house of Friars Minor of the New Abbey, in the county of Kildare, with its possessions»; and resided there at least during 1583–84, when he served as a commissioner of musters for the county. In 1590 his lease of New Abbey was forfeited for non-payment of rent. The Dublin house he used for business convenience; the conversations described in Bryskett's 'Discourse of Civill Life' took place probably in the spring of 1584 or 1585; and Spenser came daily from neighboring Dublin to join in them. Finally, his name appears in the articles, June 1586, for the Munster «undertakers» or colonizers, as lessee of the castle and lands, 3,028 acres, of Kilcolman, in County Cork. Although the patent was not passed until 26 Oct. 1591, Spenser must have taken possession by 1588–89, since in that year he reported six English settlers on the estate and also received Raleigh as guest. Rent was fixed at £8 13*s*. 4*d*. per annum, to be doubled after Michaelmas, 1594; there is record of payment for 1592.

On removal to Kilcolman he resigned, 22 June 1588, the Dublin clerkship, to purchase, again from Bryskett, clerkship of the Government Council of Munster,— Bryskett, however, apparently reserving a share in the reversion of the office. Spenser, like his master, Chaucer, was a shrewd man of business; but his shrewdness had its nemesis. Local feeling ran high against the undertakers. On 12 Oct. 1589, Lord Roche of Fermoy, English-born but Irish by sympathies, charged Spenser with unlawful dispossession of certain lands «by colour of his office and by making of corrupt bargains with certain persons pretending falselie title.» This began a series of petty persecutions by Roche,—

once by «boycott,» making «proclamation» that «none of his people should have any trade or conference with Mr. Spenser or Mr. Piers, or any of their tenants, being English,»— another time, by «fineing» a tenant of his own «for that he received Mr. Spenser in his house as he came from the session at Limerick.» Probably for protest against Roche, as well as on Raleigh's invitation, Spenser left for London between October 12, when Roche brought suit, and December 1, when the first three books of the ‘Faerie Queene’ were «entered.»

Since, 10 years before, Spenser had boasted of «overgoing» Ariosto, he had grown in knowledge and experience: Bryskett draws him less poet than philosopher. Even in 1579, no two literary temperaments could have been more antipathetic than the Platonizing Puritan of Cambridge and London and the Horatianly cynical, witty Ferrarese. After 1580, the ‘Orlando Furioso’ remained for Spenser a storehouse of plot and incident and character in silhouette (cf. R. E. N. Dodge, Publ. Mod. Lang. Assoc. Amer., 1897); but for the essential things,— spirit, manner, ideals — Tasso's ‘Gerusalemme Liberata’ became his intimate model. The later epic better fitted Du Bellay's ideal in its high seriousness — at once religious, moral, and patriotic,— in its form and manner sensitively refined, pictoral, and — as the Renaissance understood the word — classic. Temperamentally, Tasso and Spenser were sympathetic, even — difference of creed notwithstanding — in their sombre religiosity. Elizabeth in 1584 envied the Duke of Ferrara his laureate; Spenser was even then preparing to fill Tasso's rôle in England.

The ‘Faerie Queene’ was designed to be an allegory, in 12 books of 12 cantos each, of the «ethike part of philosophy» which concerned private conduct; and a sequel was promised, allegorizing political or princely conduct. To add the national note, the hero was to be *Prince* Arthur embodying the private virtues, *King* Arthur the political. The central motive of this virtual «conduct-book» shows the influence of the most famous «conduct-book» of the age, Castiglione's ‘The Courtier.’ Prince Arthur's mystic love for the dreamed-of Gloriana — the faith whence all his good works spring,— while it has roots in mediæval romance, is raised to a power for righteousness by the Neo-Platonism to which, as applied to womanly influence, Castiglione, following Bembo, gave international vogue.

Harmonization of Neo-Platonism with Catholic theology had been a commonplace since Ficino, not to say Origen; Spenser's idea was to harmonize Neo-Platonism with Puritan theology. His method can be seen in the ‘Fowre Hymnes’: the first pair, composed in the «greener times» of his youth, superbly voice a nearly pure Neo-Platonism of the type of Benivieni; the second pair, 1596, somewhat mechanically transpose the theme to the key of Tyndale and Calvin. Following his eclectic method, Spenser in the ‘Faerie Queene’ incorporated other doctrinal items, notably Aristotle's doctrine of «moderation» and his moral categories, as already modified by Italian commentators into 12. The allegory of the Puritan's «battle between the Spirit and evil lusts»— error, hypocrisy, pride, despair,—«the chief and principal work of faith, the battle of the Spirit against the flesh» (the «Old Dragon»),— the comforting by divine Truth (Una) of his soul overcome by Despair,— the necessary mediation of divine Grace (Arthur) — all this is already adumbrated in Tyndale's ‘Prologue upon the Epistle of Saint Paul to the Romans’ (republished in Works, 1573).

Spenser's problem was to express this eclectic system through a romanic narrative itself constructed from many sources — Classic, Mediæval, Renaissance — the personages of which should represent its categories, and their ordered adventures its dialectic; and, at the same time, also to «shadow forth,» as through a double veil, the religious, political and contemporary social history of England. No other European poet except Dante had essayed so prodigious a task; and Spenser *may* have been emulating Dante. But the English poet was infinitely less happy in his medium: the cloudily shifting scenes, monotonous ill-motivated exploits, vaguely or externally differentiated characters of popular chivalric fiction offered but a poor substitute for the Tuscan's accurately symbolic, yet localizable and tangible other world of nicely discriminated human realities.

The curiously protean poem, however, even in its weakness, was nicely calculated to contemporary taste. It had something for all,— high if vague doctrine for thinkers,— classical learning and Italianate elegance for scholar and dilettante,— romantic story, graphic picture, piquant gossip for courtier or fine lady; and the cultivated Elizabethan often united in himself all these moods. Spenser was at once acclaimed supreme poet of his generation. Exception may have been taken by some, as by Jonson, to the artificially archaic diction — attempt on Pleiadiste principles, to dam up current speech at its Chaucerian «well of English undefyled,» or to the complicated stanza itself probably also from Chaucer — the ‘Monkes English poet, unless Chaucer, has been in his Tale’ stanza capped by an Alexandrine; but no lifetime so undissentingly lauded.

In February 1591 an annual pension of £50 was allotted, a stipend — if paid! — worth several times that of the present Laureate. Spenser was probably disappointed, however, for another reason. On his own testimony (especially, F. Q. VI, xii, 41) and that of contemporaries, his writings had angered all-powerful Burghley. Puritan Leicester's partisan and protégé, Spenser had lost no opportunity to attack the policy, as well as by innuendo to insult the character of Leicester's lifelong opponent. No contemporary could have failed to find Burghley among the «bigge Bulles of Basan» of the «September» eclogue (l, 124), or in the arraignment of official «graft» of ‘Mother Hubberds Tale’ (ll. 515 ff.), or in the libel of «counsellor» Fox (*ib.* ll. 1127 ff.), or in the jealously mean-spirited minister of the ‘Ruines of Time’ (ll. 447 ff.). From a hostile viewpoint, the cap fitted. Even loyal Harvey later («Fowre Letters,» ed. Grosart, I, pp. 164–165), regretted that «Mother Hubberd, in heat of Choller, forgetting the pure sanguine of her sweete Faerie Queene, wilfully overshot her malcontented selfe.» Apparently both ‘Mother Hubberds Tale’ and ‘The Ruins of Time’ were suppressed or «cald in againe» (cf. Pref., ‘Father Hubbards Tales,’ 1604; John Weever: ‘Epigrams,’ 1599). Burghley, long-suffering with Leicester himself, may well have blocked preferment in England for Leicester's “man.” Such seems to be the veiled grievance of ‘Virgil's Gnat,’ Spenser (“Gnat”) for serving Leicester (“Shepherd”) against Burghley (“Snake”) is sent off to Ireland (“waste wilderness. . . Cimmerian”).

Spenser remained in England until after the beginning of 1591. ‘Daphnaïda’ was dedicated from “London, this first of January, 1591.” The date is undoubtedly “New Style.” The lady, Douglas Howard, whose death is lamented, died late in 1590; and the dedication of ‘Colin Clouts Come Home Againe’ to Raleigh “From my house at Kilcolman, the 27 of December 1591” circumstantially proves Spenser's return. Assumption of a dramatic fiction in the latter dedication (cf. P. W. Long, N. Y. *Nation*, 1 Nov. 1906) is uncalled for: use of “New Style” dating is by no means uncommon among literary Elizabethans; Gascoigne as early as 1575 appears to have used it side by side with “Old Style” (cf. J. W. Cunliffe: ‘Supposes and Jocasta,’ Boston, 1906, p. vi, n. 1); Jonson used it mainly; in the ‘Shepheardes Calendar’ and in ‘Amoretti’ IV, Spenser starts the “new yeare” with January. The ‘Daphnaïda,’ perhaps built on the lines of Chaucer's ‘Boke of the Duchesse,’ is itself a “funeral complaint” set in a “vision,” and in the falsetto key of hired mourning; its representation of the hapless lady by an heraldic pet lion is a monumental piece of bathos.

A collection, entitled ‘Complaints,’ ‘entered’ 26 Dec. 1590, appeared 1591. The poems were mostly earlier ones, revised, and were possibly published before. Of the ‘Ruines of Rome’ and ‘Mother Hubberds Tale’ there is a manuscript extant decidedly varying from Ponsonby's text (Brit. Mus. Add. MS. 34064; cf. ‘Modern Language Notes,’ XXII, No. 2). Ponsonby's foreword, accepting responsibility for the volume, and referring to Spenser's “departure over sea,” would naturally indicate that the collection was “made up” in the author's absence. But Spenser was certainly in England when the book was “entered”; and Ponsonby would hardly have “pirated” from his best client. Doubtless Ponsonby's foreword, like E. K.'s “glosse,” was a “blind” to avert possible consequences from such plain speaking as the ‘Complaints’ contained.

The common motif of these is that of mediæval “tragedy,” — the ever-turning of Fortune's wheel and the upsetting of great expectations. The theme, modified by the antique notion of “Fate,” still dominated the Renaissance inmagination, inspiring in England the huge ‘Mirror for Magistrates,’ the “chronicle-history” plays, and much more, including Vander Noodt's ‘Theatre’ itself. Too much may, therefore, be inferred as to Spenser's own temperament from such fashionably melancholy meditations. There is indeed strong personal feeling in them, certainly grief for Sidney and animosity against Burghley, but much is conventional literary exercise. The ‘Ruins of Time’ follows in scheme the ‘Ruins of Rome,’ translated from Du Bellay; the ‘Visions of the Worlds Vanitie’ echo the ‘Visions’ from Du Bellay and Petrarch; ‘Muiopotmos’ is an airier variation on ‘Virgil's Gnat,’ translation of the pseudo-Virgilian ‘Culex’; the idea of the ‘Teares of the Muses’ had already been developed in Ronsard's ‘Dialogue entre les Muses deslogées et Ronsard’ and in Harvey's more personal ‘Musarum Lachrymæ’; ‘Mother Hubberds Tale’ is an adaptation of ‘Reynart the Foxe’ with Renaissance accretions (cf. E. A. Greenlaw, ‘Mod. Philol.,’ Chicago, Jan. 1905).

‘Colin Clouts Come Home Againe,’ although its dedication is from Ireland, may have been written and disseminated in manuscript while Spenser was still in London. The eclogue is a kind of poetic “P. P. C.” to the poet's English hosts,— Colin telling his rustic companions about Kilcolman, of the lights — and shadows — of the Court over sea. But ‘Hobbinol’ (usually Harvey) was certainly in England. The whole piece is a model of subtly modulated compliment, scaling up to the platonic homage to Spenser's royal mistress, then resolving into the minor of the apology for his “rustic” mistress. The eclogue was printed with ‘Astrophel,’ 1595.

Shortly after Spenser's return to Kilcolman, he fell in love; and after more than a year of courtship, married 11 June 1594, Elizabeth Boyle, “cozen” of Richard Boyle, later 1st Earl of Cork. “Elizabeth's” identity is established from Boyle's memoirs (‘Linsmore Papers,’ ed. Grosart, 1868–88, in which she appears as mother of Peregrine Spenser and wife of Roger Seckerstone, whom she had married in 1603. In 1613, again a widow, she married Captain, later Sir Robert Tynt. The kindlier tone toward Ireland of Spenser's later poetry indicates domestic happiness.

On 19 Nov. 1594, five months after Spenser's wedding, Ponsonby “entered” the “Amoretti and Epithalamion written not long since by Edmund Spenser,” and issued the volume, 1595, ostensibly on his own initiative; but his vague foreword implies that he had received the manuscript from the author himself. The titular coupling of the two pieces must have suggested their dramatic connection, four little neo-classic idyls serving as a “recreative” *entr'acte*. Both describe in identical terms one heroine, stately to haughtiness, rosy-cheeked, golden-haired, blue-eyed. After the traditional sonnet-cycle formula — “the prologue, hope; the epilogue, despair” — the ‘Amoretti’ close with a lovers' quarrel, allusion to which may lie in “the paynes and sorrowes past” of the ‘Epithalamion’ (i. 32). Phrase and conceit are imitative; but — one may go awooing with conventional manners in a borrowed coat. In form, the schema of “linked” quatrains compromises between the close-knit Italian sonnet and the loose Shakesperian. The gorgeous ‘Ephithalamion,’ redeemed from mere goldsmith's work by its exuberant feeling, follows not unworthily the Italian *canzone*. To these two “goodly ornaments” for his bride, Spenser added a charming pendant in the idyl of Colin piping to his “countrey lasse,” a fourth Grace in the midst of Venus' damsels (F. Q. VI, x).

The “poet-undertaker” had been having other troubles besides the doubts and delays of his long courtship. He was again sued by Roche, and was dispossessed, by default of appearance, 12 Feb. 1595 (N. S.), of three “plough lands, parcell of Ballingrote.” To conduct his case he assigned his clerkship of the Munster council to one Nicholas Curteys, who thereafter, “upon the trust of Lodowick Bryskett and Edmund Spenser,» retained the «poor and troublesome place» until superseded by Richard Boyle, February 1598.

The second three books of the 'Faerie Queene' were finished by 1594 ('Amoretti,' LXXX). Spenser must have carried the manuscript to Ponsonby between February 1595, when he appeared against Roche, and 20 Jan. 1596, when the poem was «entered.» He dedicates his 'Fowre Hymnes' from the Court at Greenwich, 1 Sept. 1596. On November 8 he attended — as his 'Prothalamion' for it implies — the double wedding at Essex House between the Earl of Worcester's daughters, Elizabeth and Catherine Somerset, and Essex's friends, Henry Guildford and William Petre.

Now that his old patrons — Sidney, Leicester, Grey — were all dead, Spenser was courting Sidney's widow's husband, Essex, of whom the 'Prothalamion' is principally a panegyric. Meanwhile, the 'Astrophel,' an elegy for Sidney — with companion-pieces by other hands,— had appeared with 'Colin Clouts Come Home Againe,' 1595. One piece, Bryskett's 'Mourning Muse of Thestylis,' had been separately «entered» 22 Aug. 1587; and possibly, the whole series was resurrected for sake of the dedication to Lady Essex. Her acceptance of a poem celebrating Sidney's «amour» with Lady Rich further testifies to the purely «platonic» nature of that «amour.»

These publications of 1595–96 emphasize the poet's growing worldliness. Sharp-tongued radical moralist gives place to polished and discreet court laureate — by assumption if not appointment. Nobility for him is rather of caste than of character: «court and royal citadell» are the great school-maistresse of all courtesy» (F. Q. III, vi, 1). Most of his work is «occasional,» even in the later books of the «Faerie Queene' itself, his mirror is held up less to universal humanity than to the Court; historical and personal allusions multiply, relatively crowding out the moral allegory. Book V is part *apologia* for Lord Grey, who had died in 1593, part chronicle — often *chronique scandaleuse* — of national and social affairs «writ to the meridian» of Hampton and Greenwich. The libel on Mary of Scots as «Duessa» brought from King James, 12 Nov. 1596, a demand for legal redress. As art, however, the best of this later work realizes to the full the Italianate Renaissance ideal of sensuous grace (*leggiadria*),— brilliant dissolving views drawn in «an easie running verse with tender feet.»

More touched with abstract thought are the two cantos and a fragment, perhaps part of a book on 'Constancy,' and first printed in the folio works, 1609. Influenced by Burno's 'La Bestia Trionfante,' «Nature's» overthrow of «Mutability» has a touch of pantheism not quite in harmony with the rest of Spenser s frankly patchwork system. The underlying intention may be a side thrust at governmental «mutability» in Irish policy, parallel to the indictment in the 'Veue of the Present State of Ireland.' This was first printed by Sir James Ware in 1633, but endorsed by Spenser «*finys* 1596,» and «entered» by Mathew Lownes, 13 April 1598. By implication of the opening sentence, it was written in England. In the dialogue, Eudoxus, the «wisely docile,» is convinced by Irenæus, the «peace-lover,» that distraught Ireland needs «violent medecynes» — Machiavelli's «*medicine forti.*» The treatise was disseminated in manuscript copies, of which several are extant. Later, early in December 1598, Spenser, a fugitive at Cork, used Tyrone's disastrous uprising as an object-lesson for the Queen of his 'Veue,' in 'A Briefe Note of Ireland,' with «Certaine points to be considered of in the recovery of the Realme of Ireland.» In 1657, «Iron» Cromwell found in Spenser's sympathetic 'Veue' reason for maintaining Spenser's grandson in possession of Kilcolman.

On 30 Sept. 1598, Spenser was made sheriff of Cork. Less than a month later, Tyrone's rebels burned his house over his head; he and his family fled for their lives to Cork. Whether or no was added the horror of «a little child new born» perishing in the flames, as Jonson told Drummond, the shock and later privations undoubtedly broke the poet's frail constitution. He sailed, December 9, with despatches from Sir Thomas Norreys, president of Munster, to the Privy Council; delivered these December 24; on Saturday, 16 Jan. 1599, died at Westminster,— according to Jonson, «for lacke of bread in King Street,» having declined Essex's aid. Jonson may have exaggerated; but contemporaries agree that the circumstances of his death were tragic.

He was given a sumptuous funeral — at Essex's expense, Camden says; and Browne, in 'Britannia's Pastorals,' declares that money given by Elizabeth for a monument was misappropriated. The present monument, restored in 1778, was erected by Anne, Countess of Dorset, in 1620.

The commingling of classic and romantic elements in Spenser's poetry has led — as with the Pleiade — to a curiously fluctuating appreciation. To his own age another «Virgil,» Spenser seemed to the «Augustan» age a barbarous «Goth,» to the Romanticists a genius full of glamor and witchery, to later Realists a brilliant, but uneven, word-painter. Each appreciation was justified from its own viewpoint. Milton valued the «teacher»; D'Avenant and Dr. Jonson patronized the evoker of pretty, but distempered, visions. The Jacobeans — the three Fletchers, Browne, [illegible] More, Joseph Beaumont, Bunyan, Cowley, read and imitated Spenser as Jonson recommended, mostly «for his matter,» writing didactic allegories in heroic or pastoral vein. Milton and Dryden acknowledged him their spiritual master. Prior opened a long series of external imitation in form — verse and archaism. With Thomson's 'Castle of Indolence' and 'Seasons' begins a richer discipleship, which — sobered by the joint influence of Milton — has lasted to the present day, but culminated in the contemporaries of Wordsworth and Keats. Spenser has amply earned the title of «poet's poet,» for his own exquisite art, and for the art begot in others: he has been the «Warwick» of English poets, the poet-maker. His manner has not invited translation: the few German and Italian versions from the 'Faerie Queene' are unimportant. For so great a poet his influence has remained singularly national. See FAIRY QUEEN, THE; SHEPHERD'S CALENDAR, THE.

Bibliography.— The fullest life of Spenser is by A. B. Grosart (Vol. I, 'Complete Works,' 10 vols. but 9 issued, 1882 ff). Grosart unearthed much new information; but his enthusiasm often runs away with his judgment. J. W. Hales (Globe ed., Spenser 1897), and Dictionary of National Biography summarizes as established fact most of Grosart's inferences. The most suggestive studies of Spenser's personality as man and poet are by Lowell (1875), R. W. Church, 'English Men of Letters' (1879), and J. J. Jusserand 'A Literary History of the English People' (Vol. II, 1906). A composite photograph of the three portraits, each of which is from a different viewpoint, is not unlikely to be near the truth.

A critical edition of Spenser's Works remains a desideratum. The Globe text is as good as any. H. J. Todd's variorum edition (1805) is the basis for most following annotations through J. P. Collier's (1859). The 'Faerie Queene' has been separately annotated by Ralph Church (1758), Burves (1872), K. M. Warren (1897), and others; Books I, II for school use, by G. W. Kitchin (1868); Book I more elaborately, by H. M. Percivall (1894); 'The Shepheards Calendar,' excellently, by C. H. Herford (1895). The first edition of the 'Calendar' has been reproduced in facsimile by H. O. Sommer (1890). An 'Outline Guide to the Study of Spenser,' by F. I. Carpenter (Chicago 1894), will be found useful.

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SPENSERIAN STANZA. See Spenser, Edmund.

SPERM-WHALE. See Whale.

SPERMACETI. See Whale.

SPERMATOPHYTES. See Botany; Fungi.

SPERMATOZOON, the male element; one of the flagellated cells developed in the testes (see Testicle) of male animals, and conveyed in their secretion (sperm or semen) to an egg of a female of the same kind, by copulation or otherwise, for the sake of coalescing with (impregnating or fertilizing) that egg, and setting up the developmental changes which result in the formation of a new living being. The spermatozoa are extremely minute bodies, nearly always motile, usually slender and whiplike, tapering toward one extremity, and commonly with a rounded head at the other; and are developed by a succession of cell-divisions from certain cells in the testicle, called the primitive male cells, similar in character to the immature ova. It appears an individualized living cell, swimming about in the semen. The manner in which the spermatozoon unites with the ovum is explained in the article Embryology. It was the belief of a school of naturalists of the 17th century, called «Spermatists,» that the whole of the resulting being was enfolded in and derived from the spermatozoon; while an opposing school the «Ovulists» asserted that in the egg alone was contained the germ of the animal. (See Preformation). Neither was right; the development of a fœtus results from a union of both male and female elements. See Cell; Embryology; and consult authorities mentioned thereunder.

SPERMOPHILE, a ground squirrel of the genus *Spermophilus*, of which more than 20 species exist in the United States while several occur in Europe and Asia. They are rodents of a squirrel-like form. They live in underground burrows, bring forth their young in the burrows, are prolific, and in northern districts they hibernate in the fashion of marmots. They occur in the United States westward from Illinois, and into Mexico and Canada. When they become numerous in cultivated sections they are a troublesome pest, owing to their burrowing habits, although their burrows are not so extensive as those of the prairie dogs. They are commonly, but erroneously, called gophers in western districts; while in Europe they are known as suslik. The flesh is edible.

SPERRY, Charles Stillman, American rear-admiral: b. Brooklyn, N. Y., 3 Sept. 1847; d. Washington, D. C., 1 Feb. 1911. He was graduated at the United States Naval Academy in 1866, and was promoted through the various grades to commander 22 June 1896, captain 1 July 1900 and rear-admiral 26 March 1906. He was on ordnance duty at the Brooklyn Navy Yard during the Spanish-American War; was commander of the *Yorktown,* stationed at Manila in 1899; and in 1903 was appointed president of the Naval War College at Newport and a member of the General Board. He commanded the Second Squadron of the United States battleship fleet in the first lap of its cruise around the world in 1908–09 and was its commander-in-chief on its departure from San Francisco, 7 July 1908, succeeding Rear-Admiral Evans. He was retired 3 Sept. 1909.

SPERRY, Elmer Ambrose, American electric engineer: b. Cortland, N. Y., 12 Oct. 1860. He studied at the Cortland Normal School in 1876–79 and at Cornell University in 1879–80. He founded the Sperry Electric Company in Chicago in 1880, engaging in the manufacture of arc-lamps, dynamos and other electrical appliances. He perfected one of the first arc-lamps, and invented the gyrocompass, aeroplane and ship stabilizers, the highest intensity searchlight (1,500,000,000 candle power), gas engines, fire control apparatus and many special devices for the United States navy. Since 1910 he has been president of the Sperry Gyroscope Company, Brooklyn, N. Y., engaged in manufacturing his own inventions. He has received many prizes and awards for his inventions, both at home and abroad. Since 1915 he has been a member of the Navy Consulting Board.

SPERRYLITE, an important ore of platinum, consisting of the arsenide Pt As₂, containing 56.5 per cent of the metal. Occurs at mines in Albany County, Wyoming.

SPESSARTITE, a gem variety of garnet obtained from mines at Amelia, Va.

SPEUSIPPUS, spū-sĭp'ŭs, Greek philosopher: b. about 394 b.c.; d. Athens, 336 b.c. After the death of his uncle Plato, he became head of the Platonic school or Older Academy. Of his philosophical works, in which he taught a doctrine differing but little from Plato's, nothing is left but titles and fragments. He held that nature was not wholly good since wickedness is an essential factor in the progress of humanity.

SPEYER, James, American banker: b. New York, 22 July 1861. He was educated at Frankfort, Germany, and entered his family's banking-house in that city in 1883. He was subsequently connected with the Paris and London branches of the firm before returning to New York. He became the head of the family firm of bankers and was an officer in many other banks and trust companies. He was one of the founders of the Provident Loan Company and a trustee of Teachers' College, Columbia University, to which he in 1902 presented the Speyer School. He was actively connected with the defeat of the Tammany Hall organization in 1894.

SPEYER, or SPEIER. See Spires.

SPEYERS, Arthur Bayard, American naval officer: b. New York, 15 Aug. 1846; d. Montreal, province of Quebec, 19 Nov. 1918. He was admitted to the United States Naval Academy in 1863, where he remained until six months before the close of the Civil War in 1865, when he was assigned with other members of his class to duty as acting midshipman on vessels assigned to destroy privateers. At the close of the war he returned to the Naval Academy, where he was graduated in 1868. His first assignment was to the North Atlantic fleet. A year later he was promoted to the rank of ensign and transferred to the *Benicia* on the Asiatic station. Two years later he was promoted to master, and while serving on the *Kansas* in 1874 was commissioned lieutenant. He was made lieutenant-commander in 1895. Soon after the beginning of the Spanish-American War in 1898 he was assigned to command the *Cæsar* and took part in bottling up Cervera's fleet in the harbor of Santiago de Cuba. At the close of the war, Commander Speyers was placed in command of the *Glacier*. He retired with the rank of rear-admiral, 11 Jan. 1905.

SPEZIA, Italy, city in the province of Genoa, on the Bay of Spezia, 56 miles by rail south of Genoa. It is built near the site of the ancient Roman *Luna*. It became the chief naval station of Italy in 1861, since which time its size has greatly increased. The harbor is the largest and best in Italy, and its entrance is protected by forts and by submarine embankments two miles long. It has large shipbuilding works, docks and a marine arsenal, as well as barracks and a hospital. The gulf and the surrounding country are especially beautiful, and the town has a considerable business as a winter resort, and is popular for bathing in the summer. There are exports of oil, pig lead, silver, wine, fruit, flour, marble and sandstone. Pop. (commune) 73,599.

SPHACTERIA, sfăk-tē'rĭ-ą (the ancient Sphagia), Greece, a narrow island, about two and one-half miles long, lying across the entrance to the Bay of Pylos on the southwestern coast of Messina. It is noted for two famous naval battles which took place off its shores, one in ancient and one in modern times. See Peloponnesian War; Navarino.

SPHAGNUM, a genus of mosses, the only one of the family *Sphagnaceæ*, growing in moist places or bogs, in such quantities as to form a soft, thick carpet, saturated with water, whence their common name of bog-mosses. They are perennials of feathery aspect, growing at the top of the stem from year to year. Some of the numerous lateral branches grow upward, and form tufts at the apices of the stems, while others droop downward and envelope the lower portion of the stem. Each year one of the side branches grows so strongly as to rival the main head, and thus gives a forked appearance to the plant. The lower end of the stem is continually dying away, eventually forming peat, and thus frees the lower ends of the branches, which thereupon start into independent plants. Special branches, differentiated by structure and color, produce the sexual organs, the two sexes being either on the same plant or separated. The spore-capsules are on short branches and are globular, with a lid. The leaves are small, translucent, and, like the stem, have strata of transparent cells, connected by holes, which are capable of absorbing and retaining much water. This ability to retain water has made the sphagnum moss very valuable to florists, who use it for packing bulbs and flowers, and it forms a large part of the compost employed for growing pitcher-plants and orchids.

SPHALERITE, the commonest ore of zinc. See Blende.

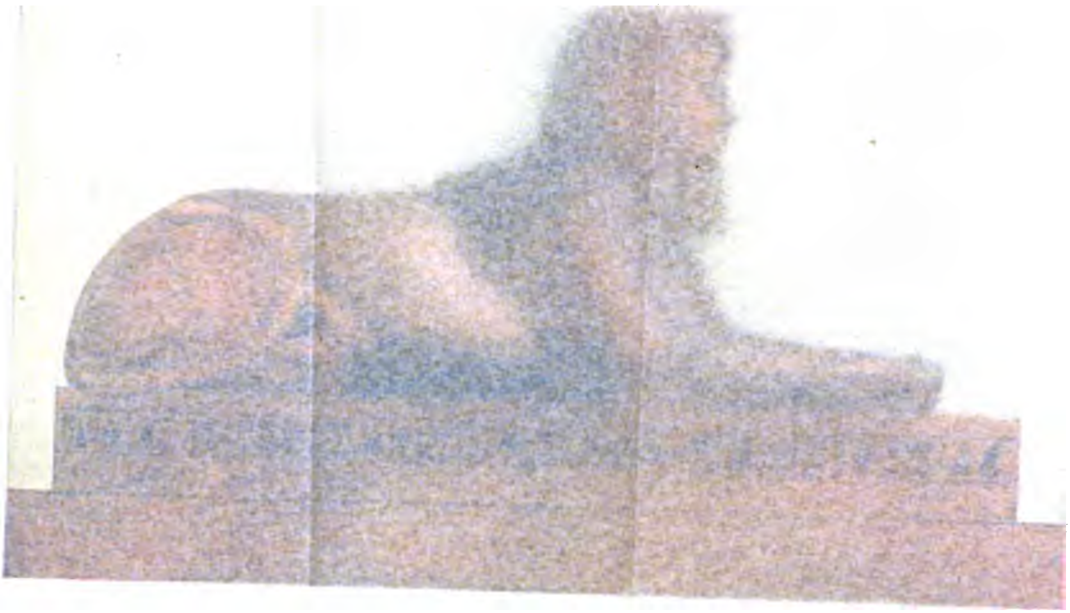
SPHENE. See Titanite.

SPHERE, a ball or globe, defined in geometry as a solid bounded by a surface which is everywhere equally distant from a central point. If an arc equal to a semi-circle be made to rotate about the straight line joining its extremities, it will generate in space a spherical surface. Any section of a sphere by a plane will be a circle; when the plane passes through the centre of the circle of the section is a great circle; any other section is a small circle. A straight line passing through the centre and terminating at the surface is a diameter; a straight line from the centre to the surface is a radius. The surfaces of spheres vary as the squares of their radii. If a spherical surface be cut into rings by a set of parallel planes, the surface of each ring is a zone, and the area of any ring is proportional to the distance between the two planes which determine it, and the area of the ring is to the total area of the spherical surface as the distance between the two planes is to the length of the diameter. The mathematical relationship of things is apparent from the discovery by Archimedes (q.v.) that the surface of a sphere is equal to the curved surface of a circumscribed cylinder, while the volume is precisely two-thirds that of the cylinder. See Trigonometry.

SPHERICAL HARMONICS. See Harmonic Analyses.

SPHEROGRAPH, a disc upon which is placed the earth in stereographic projection, the meridian and latitude lines being laid down completely, so that with a ruler and index a navigator may determine angular positions in great-circle sailing. It is also useful in a variety of problems in spherical geometry.

SPHEROIDAL STATE or CONDITION, the state of a liquid when it presents spherical phenomena caused by placing it on a very hot surface; the so-called «caloric paradox.» Leidenfrost observed that a drop of water placed on a very hot surface assumed a spheroidal shape and did not touch the surface. Boutigny made a more thorough study of the subject, and experimented with various liquids. The limit of temperature of the hot surface is the temperature at which the drop of liquid spreads on it and boils with a hissing noise.



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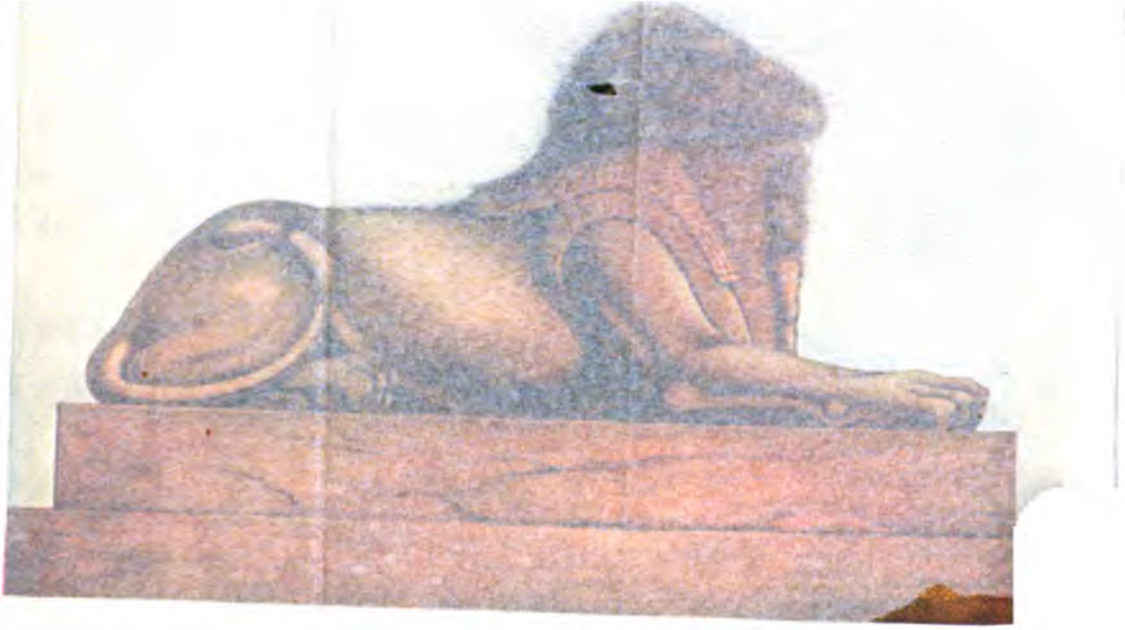

CRIOSPHINX

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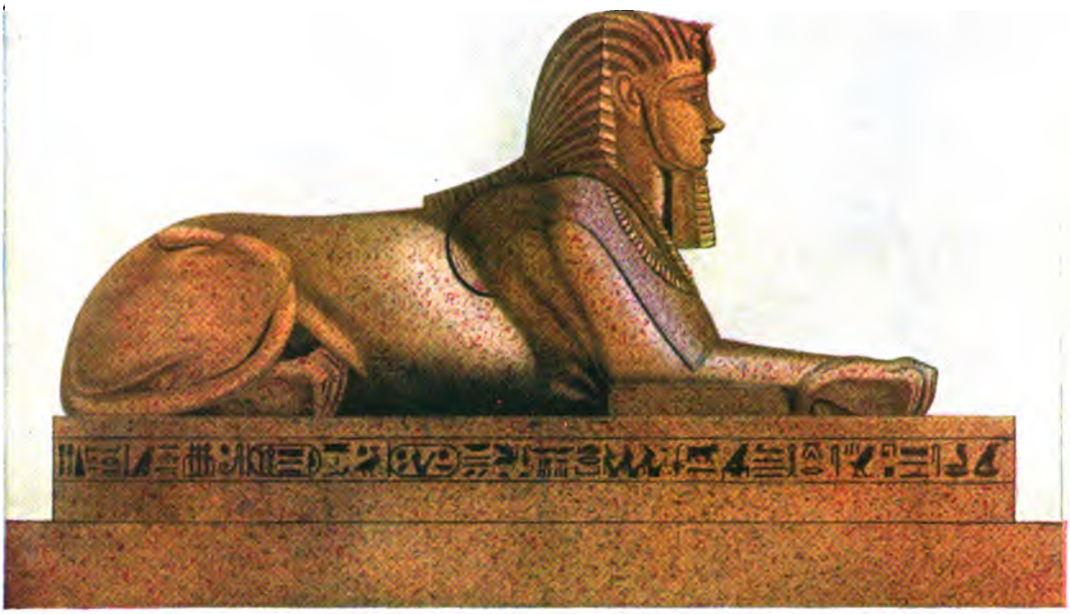

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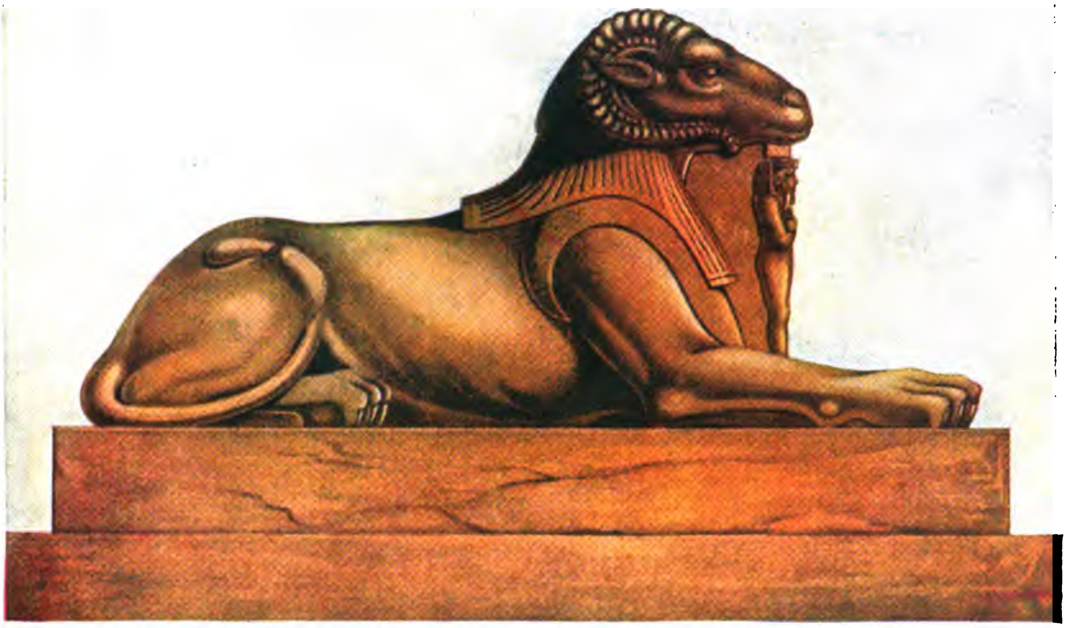


CRIOSPHINX

Boutigny places the limit for water at 142° C., and at 61° C., for ether. The temperature of a drop of liquid in the spheroidal state is always below that at which the liquid boils, and for this reason the interesting experiment of freezing a small quantity of water on a hot platinum dish may be performed. The dish is heated almost to a white heat, when a small quantity of sulphurous acid is placed upon it, and assumes the spheroidal state; the boiling point of sulphurous acid is —10° C., and in the spheroidal state it is a temperature less than 10° C.; a few drops of water added to the sulphurous acid is immediately frozen, and may be thrown out of the dish, a mass of ice. Substituting nitrous oxide for sulphurous acid, and mercury for water, mercury may be solidified in the same manner.

That the liquid does not touch the surface is made evident in various ways, such as that of making the surface a flat plate and observing that light passes between the spheroid and the plate, or letting a conducting point enter the spheroid from above, and seeing if a current of voltaic electricity will pass between the spheroid and the dish. The temperature of the spheroid is kept low by the rapid evaporation which is going on at its surface; the spheroid is kept from touching the dish by a cushion of vapor, and this cushion is non-conducting, so that the heat which affects the spheroid is heat radiated from the dish; as soon as the temperature of the dish is less than that component to provide a cushion of vapor sufficiently dense to sustain the spheroid completely from contact with it, the spheroid spreads on the dish and is quickly dissipated by the heat which it now receives by contact. Consult Barker, ‹Physics› (1893); Daniel, ‹Text-book of the Principles of Physics› (3d ed., 1894); Stewart, ‹Elementary Treatise on Heat› (6th ed., 1895).

SPHEROIDAL WEATHERING. See Exfoliation.

SPHINX, The, a mythological monster variously described but usually with a lion's body, the head and sometimes the breasts of a woman, the wings of a bird and a serpent's tail, supposed to represent some ancient symbolism. The Egyptians called the sphinix Hu, or Neb (Lord). Its present name is derived from the Greek *σφιγξ*, sphinx, «the binder.» «strangler;» from *σφιγγειν sphingein*, to strangle.

The sphinx. like the obelisk (q.v.), in the mythology of the ancient Egyptians, represented the solor deity, *Ra,* and they were originally placed, like the obelisks, in pairs at the entrances of the temples and palaces, not for ornamental purposes only, but mainly for worship. It was emblematical of *Har-em-klu,* «Horus on the Horizon,» the Harmachis of the Greeks, representing the conflict of lights and darkness, the conquest of Horus over Typhon, the slayer of his father, Osiris. The Pharaohs of the Middle Kingdom multiplied their number, and placed rows of them on both sides of the principal avenues leading to the temples and palaces of Thebes. The avenues of the temple at Karnac were bordered by hundreds of these sphinxes, many of which still remain, headless and disfigured. Those, however, were not only *andro* sphinxes, but of the *hieraco* and *crio*-sphinx type.

All nations of antiquity seem to have held those monstrous beings of various shapes and forms as objects of awe, compelling adoration and worship. The ancient Egyptians believed that the sphinx also represented the Pharaoh who styled himself *Se Ra,* the son of *Ra.* Thus, on the pyramidion of the Obelisk of Thothmes III, in Central Park, there is a figure of that Pharaoh paying homage to a sphinx upon a pedestal, which in itself is a representation of the king. In other words, the king is worshipping himself.

The portals of the rising and setting sun were guarded by those lion deities. Even the Bible speaks of the Cherubim, which were placed to guard the entrance of the Garden of Eden. The real meaning of cherub, however, is still in dispute, but all agree that it was a composite winged being. The prophet Ezekiel describes similar beings in connection with the Divine Throne. The Assyrian conceptions of their guardian deities were chiefly represented by human-headed lions or bulls; eagle-headed human bodies, or vice versa.

The sphinxes of the ancient Egyptians were, as already mentioned, of three different forms, namely, (1) *Andro*-sphinx, a human-headed lion, symbolizing strength and intelligence; (2) *Crio*-sphinx, a ram-headed lion; (2) *Hieraco*-sphinx, a hawk-headed lion.

One of the most important relics of ancient Egypt is the colossal human-headed lion, in front of the second pyramid of Gizeh. Even in its present dilapidated state it elicits the wonder and admiration of the traveler. The Arabian traveler and historian Abdullatif (1162–1231 A.D.), in his description of the pyramids and sphinx, says: «At a little more than an arrow's flight from the pyramids is a colossal figure of a head and neck projecting from the earth; the name of the figure is ‹*Abu'l-hol*›» which means «Father of Terrors.» The same authority speaks of it as having excited his attention more than all the other marvelous monuments put together that he had seen in Egypt. «Everything,» he observes, «in spite of its enormous size, was in proportion to nature.» «In a face of such colossal size» he wonders «how the sculptor could have been able to preserve the exact proportions of every part, seeing that nature presented him with no model of a similar colossus, or anything at all comparable.» (DeSacy's trans., p. 180).

It is at a distance of about 1,800 feet from the Great Pyramid, and is carved from the solid rock upon which it rests. Its dimensions are (Smith's measurements):

	Feet	In.
Height of head from bottom of chin to forehead	19	
Horizontal diameter on level of forehead	23	
Circumference at level of forehead	72	
Horizontal diameter near broadest part of headgear	29	
Circumference at broadest part of headgear	91	
Height of neck, 5 feet; horizontal diameter	22	
Circumference of neck	69	
Total height of the monument, according to Mariette Bey	65	
Ear	6	5
Nose	5	10
Mouth	7	8
Face, in the widest part across the cheek	13	7
Whole length of body	140	
Outstretched paws	50	

Since Adbullatif's description of its features, the appearance and condition of the sphinx have undergone great changes. The lower part of the headgear and beard are no more. The features, owing to the iconoclastic propensities of the Kopts and Arabs, are no more «gracefully smiling,» as of old; but have a strange, weird expression, amply justifying the Arabic name «*Abu'lhol,*» Father of Terrors.

As, regards the date of this monument, Egyptologists do not agree. The latest authority, Budge (‹History of Egypt,› Vol. II, p. 49), assigns the period of the Great Sphinx to probably one of the builders of the Great Pyramids, but «it is quite possible,» he adds, «that it may be much older.» Mariette Bey, Maspero and others attribute it to a much more remote antiquity; to the *Hor-shesu,* the followers of Horus.

The Phœnicians and Greeks imported the sphinx from Egypt and reproduced it in various shapes and forms, of all sizes and of different materials. Some have face and breast of a woman, the body of a winged lion and tail of a serpent, and many other varieties, according to the fancy of the artificer and sculptor. These found their way back to Egypt whence they originated, but in different forms.

SPHYGMOGRAPH, sfĭg'mō-grạf, an instrument for recording the movements of the pulse. The first true sphygmograph was the invention of Vierordt, and has received various improvements. In its most improved form it consists of a small rod which moves vertically up and down, and in so doing communicates motion to a thread passing round two horizontal movable axes, one of which moves a needle that serves as an index, while the other moves a wheel. A pen held in a jointed stalk follows the movements of this wheel and records its motions on a strip of paper, which is passed beneath it by clock-work. The record has the appearance of a more or less irregularly undulating line. At the lower end of the vertical rod is a small plate, rounded on the lower surface, and when the instrument is in use this plate is brought into contact with the skin above the pulse, which is kept in position by a rest supporting the wrist. Before the instrument is set in full operation the position of the pulse is slightly varied until it is ascertained in what position it gives the strongest impulse to the vertical rod, which is indicated by the index-needle on a graduated scale. Obviously, any other form of recording instrument that measures the pulse-beats may bear the name, and some have been invented, but if the test be made directly of the heart action, the name is scarcely appropriate. One of these latter is the electrocardiograph, which measures the cardiac rhythm by electric reaction on a galvanometer principle. Consult Sanderson, ‹Handbook of the Sphygmograph.› See Pulsimeter.

SPICE-BUSH, a tall shrub (*Benzoin benzoin*), of the laurel family, frequenting moist woods and the edges of streams. It is conspicuous when leafless on account of its slender branches and olive-green spotted bark, which has an aromatic odor and taste, suggesting to the Indians and frontiersmen, its use as a stimulative tea. Very early in spring, the twigs are covered with tufts of honey-scented, tiny flowers, with yellow calyces. They are either polygamous or diœcious, the male flowers having many stamens, and the females a globose ovary and several staminodia. The leaves, which follow, are oval or obovate and short-pointed. The fruits are ripe in late summer and are oval drupes, bright red in color, and most disagreeable in flavor. The wood of this shrub is termed spice-wood.

SPICE ISLANDS. See Moluccas.

SPICES, a popular name for such plant components, having essential oils of aromatic odor and pungent flavor, as are used direct and blended in for seasoning food; in fresh food nearly always ground, in preserves and pickles always whole. Their companions spread on, as mustard or used only in extracts, as vanilla, are not so reckoned, but as condiments, flavorings, etc. They represent most parts of the plant beyond the wood; cinnamon and cassia are the bark; ginger the root; cloves the flower-bud; allspice (pimento) and pepper, caraway and coriander, the fruit; nutmeg the kernel, mace its wrapper; cumin and dill the seed. All are tropic save the allied group of caraway, coriander and dill, now naturalized in temperate climes — and significantly, not often thought of as «spice»; and all foreign but these and some ginger.

The Spice Trade in History.— The supreme importance of this in revolutionizing and generating modern civilization has never been set forth, because it is not recognized as the leading factor in the old Eastern commerce. Yet not only did it lead directly to the discovery of America and the sea route to the far East, but for centuries it was a chief agent in provoking world wars, determining the rise and fall of states, creating the present status of Europe and the Eastern Question, and even twice remade the world's religious history, first by making Mohammedanism a world power and long after by conditioning the time and early fortunes of the Reformation. The relation of spices to earlier European food which caused this importance was something hardly conceivable at present. All could now be dispensed with at little loss beyond some pleasure; while till recent times they were an exigent need for comfort, health, and with the delicate even life. The winter food of most mediæval English, for instance, was little but meal and salt junk — bacon from lean pigs, beef from scrawny cattle, insufficiently kept by dear and unpurified salt, and so half rotten by spring; washed down by ale without hops. Besides the results in scurvy and endless skin diseases — the source of the old tradition of sulphur and molasses with which women were wont to cleanse children's blood in spring — the meals were not only monotonous and pleasureless but hard for the sick and queasy to force down and bad for them if they did so. Hence in the Middle Ages, perhaps the first call beyond bare nominal aliment was something to make unpalatable food palatable, to tempt invalid appetites and save drooping lives as well as to make eating a satisfaction, and spice became the foremost dream of luxury that was a necessity. The trade to the East, for it was not the only element of that trade, but it was the most vital, the only one that was literally in some measure of life and death, even though the sugar, currants, raisins, almonds, etc., of South Europe and the Levant were also alleviations.

Perfumes, dyewoods, jewels, were agreeable accessories; even drugs could be more or less matched in service: but absence of spices took much of the savor and some of the fibre out of life.

A few of the larger manifestations of the trade will show that the above review is not a fantasy. It is true that the agency of Eastern commerce in causing the Crusades is much overstated, from the modern economic and rationalistic dislike of allowing the old weight to religious feeling. But long before their time, it had assured their coming by creating their foe and need. From the earliest epochs, Arabia had gone through cycles of development corresponding to the routes of trade from the East to Europe. In times of West-Asian peace or the mastery of strong states, this normally went overland, leaving Arabia unfertilized by it, barbarous and disintegrated; when interrupted by war or anarchy, it went around Arabia by the Red Sea and across Suez, creating or redeveloping Arabian coast cities, spreading new needs and consequent political order among the tribes and raising their intellectual status. The Roman-Persian wars of the 6th century thus deflected Eastern trade and made Mohammed's career possible. Later, the trade enriched the Italian cities as the distributors of its goods to central and northern Europe, and the rivalry of Venice and Genoa for Levantine and Black Sea monopoly of the commerce led, first to the Venetian use of the Fourth Crusade to destroy the Byzantine Empire, letting in the Turks on Europe, and then to feuds which neutralized Europe's naval strength against them. What the search for a sea route to India did for the world is familiar. Here, again, the long Portuguese struggle down the West-African coast was primarily not for trade, but to take the Moorish dominion in the rear, unite with Preston John and crush the Moors in the interest of Christianity; but the riches of the spice trade were to be the means to finance this. As to Spain's share in the search, these riches were the direct object. In both cases gold bullion was the special aim; but craving for spices was its most efficient instrument.

The supreme effect on European religion seems fantastic, but is quite simple. The German cities owed their prosperity and sometimes even existence largely to rehandling these goods from the Italian ports. Now the Cape route was so much cheaper, through not having to break bulk and reload and freedom from land tolls, that from its discovery in 1498 the Italo-German route began to lose profit and its factors to be forced out of business. By 1520 the business depression became severe in Germany, and just at this time of pinch came the exactions of the papacy for Saint Peter's. An explosion and revolt were probably not far distant in any event, from economic, political and moral reasons; but hard times acted as the final weight to release the lever.

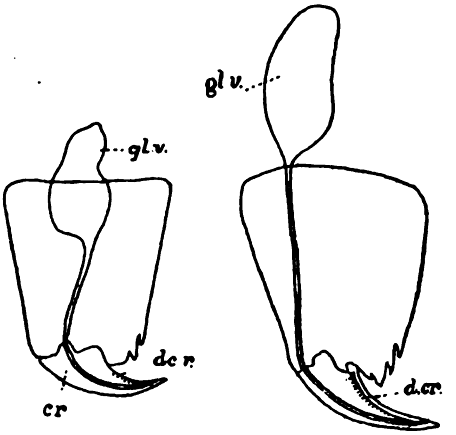
SPIDER-CRABS, a family (*Maiidæ*) of small, spider-shaped crabs represented by many remarkable and strange forms, some of them of large size, which mostly inhabit relatively deep waters. The shell is generally very hard and on the body bears numerous spines and a prominent beaked process or rostrum in front. The first pair of legs is sometimes larger than the other limbs and always bears pincers and the rudimentary abdomen possesses seven joints. Many species are found along the coasts of the United States. The best-known shallow-water forms on the Atlantic Coast are two species of *Libinia* (*L. dubia* and *L. emarginata*). The former is especially common along the shore south of Cape Cod and has the long rostrum deeply divided in front. They are sluggish creatures which make no effort to escape capture, but depend upon their hard covering for protection. Both species are scavengers and subsist upon all kinds of dead animal and vegetable matter. They conceal themselves by attaching sea-weeds, sponges, etc., to their backs, which growing as though fastened to stones afford them this additional protection. The females, with broad abdomens, are frequently found bearing eggs. The males are larger and often attain a foot in extent. A much smaller flat-bodied species is *Hyas coarctatus*, very common among sponges hydroid and sea-weeds in both deep and shallow water. *Lambrus pourtalesii* is remarkable for the great size of the first pair of legs as compared with the others. It is found in moderately deep water among rocks along most of the Atlantic Coast of the United States.

SPIDER-MONKEY, a South American monkey of the genus *Ateles*, so called from the great length of the limbs, as compared with the body and the extraordinary agility of these animals in racing about the tree-tops; no monkeys excel them in adaptation to an arboreal life, in which they are especially assisted by the length and remarkable prehensile strength of their tails. Their structural resemblance to the langurs and other highly arboreal forms of the Old World is interesting; prominent among these is the absence or rudimentary condition of the thumb, a member which is not of great service in swinging from limb to limb, when the tail serves as an effective means of grasping. The fur is usually black, but in some species gray, in one decidedly brown and in a few Central American species white on the under surfaces and dark above. They go about in small bands, make little noise and are often made captive and become confiding and agreeable pets. Probably the best-known one is the red-faced spider monkey (*A. paniscus*), called coaita in Brazil, which has a rudiment of thumb, is very black and extremely intelligent. Although only about a foot in length its tail is twice as long. Others are the chameck (*A. chameck*), 20 inches in length, the sooty-black white-bellied marimonda (*A. beelzebuth*) of Brazil, the grizzled (*A. grisescens*) and the black, yellow and white variegated spider-monkey (*A. variegatus*), which occurs in the highlands about the headwaters of the Amazon Valley. Consult Lydekker, 'Royal Natural History' (1895); Bates, 'Naturalist on the Amazons' (1863).

SPIDER-SHELL. See SCORPION-SHELL.

SPIDERS, invertebrates of the order *Araneæ*, class *Arachnida*. The English name — spider, spinder, spinner, spinster, the spinning one — comes from the functions for which these creatures have been chiefly distinguished. They are cosmopolitan in distribution; are found in

Greenland and swarm in the tropics. They show great and striking differences in form and in general habits. The spinning habit also differs widely; as one may see, by comparing the round web of a garden-spider, with the snare of the speckled tubeweaver (*Agalena nævia*), made in hedges, fence-rows, roadsides and angles of outbuildings. These typical differences in habit are commonly united with variations in structure and, therefore, have been made the basis of scientific classification by the eminent Swedish arachnologist, Dr. T. Thorell, following substantially M. Latraille. In no classification can these functional variations be disregarded; but for the use of the general public such an arrangement is most satisfactory and is here adopted. Spiders may be roughly divided into two great groups: (1) Sedentary; (2) wandering. Sedentary spiders live on or in woven habitations and take their prey by means of snares upon or near which they habitually stay. They thus have the distinction, almost unique among lower animals, of resembling man in procuring a livelihood by use of manufactured implements. The wandering spiders wholly or in large part hunt their prey afield. These groups may be thus subdivided:

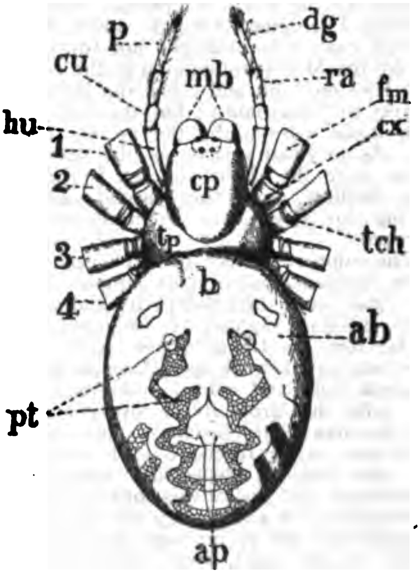


Outlines of mandibles to show location of poison sac (gl. v.) and the duct (d. cr.) leading to the opening in the falx, cr.

I. Sedentary Spiders.—(1) Orbweavers (*Orbitelariæ*), which make open webs circular or partly circular in form, composed of radii issuing from a centre and crossed with spirals armed with viscid beads for the capture of insects; these orbwebs are usually vertical, but some are horizontal. (2) Lineweavers or Netweavers (*Retitelariæ*), whose snares are mazes of crossed lines in the midst of which they hang back downward; our common house and barn cobwebs made in corners or rooms are mostly the product of lineweavers. (3) Tubeweavers (*Tubitelariæ*), which live in silken tubes spun in divers situations sometimes with a sheeted snare outspreading from the mouth, as the common speckled tubeweaver that nests in hedges, borders and grass. (4) Tunnelweavers (*Territelariæ*), making tubular nests, usually silklined, often with extensions above ground; the trap-door spider (*Cteniza californica*) is our best-known type.

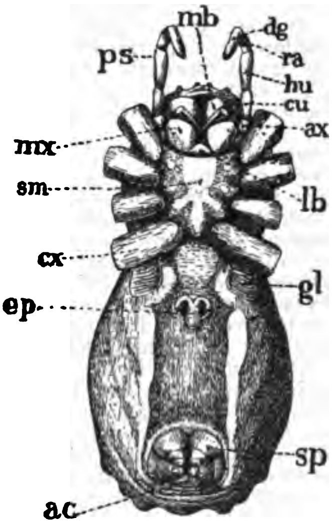
II. Wandering Spiders.—(5) Citigrades (*Citigradæ*), many of which, as the lycosids, burrow in the ground. (6) Laterigrades (*Laterigradæ*), which live upon plants and among rocks, getting their name from their rapid sidewise movements. (7) Saltigrades (*Saltigradæ*), jumping-spiders, vivacious creatures, with large, bright eyes, living on plants and walls, etc., over which they move by frequent jumps and among which they make tubular nests of thick white silk.

This arrangement Professor Thorell subsequently modified, dividing the order *Araneæ* into two suborders, *Tetrapneumones,* containing (1) the *Territelariæ;* (2) the *Dipneumones,* embracing all other tribes. M. Eugene Simon, a distinguished French araneologist, retains the two suborders, which he names (1) *Araneæ theraphosæ,* composed of three families, of which the tarantula and trap-door spider are types; and (2) *Araneæ veræ* (38 families), containing all other spiders, divided into two great groups or sections, *Cribellatæ* and *Ecribellatæ.*



Dorsal view of *Epeira insularis.* ab, abdomen; b, base; ap, apex; pt, pits that mark attachment of muscles; cp, head or cephalic part of cephalothorax: tp, thoracic part; mb, mandibles; 1, 2, 3, 4, the legs in their order, first, second, etc.; tch, trochanter of leg; cx, coxa; fm, part of femur; p, palp, dg, digital; ra, radial; cu, cubital; hu, humeral joints of palps.

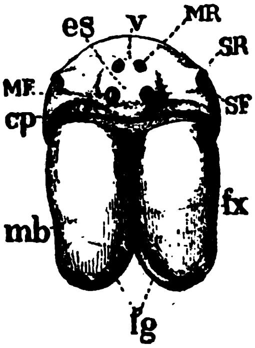
Structure.— The early entomologists included spiders among insects and in popular thought they are still so ranked; but they are widely separated therefrom. The most noticeable differences are: spiders have eight legs; insects, six; spiders have the head united to the thorax, insects separated therefrom by a neck; spiders have simple eyes, insects have compound. The spider's body is divided into two parts, cephalo-thorax and abdomen, united by a straight pedicle or stem. Two mandibles or jaws are attached to the face, each having a hollow fang folded up within a groove when at rest like a pocket-knife's blade within its handle. A small opening in the fang communicates through a minute duct with a pear-shaped poison-sac, in the upper part of the mandible and head. The poison, as in the case of snakes, is forced out when the spider strikes its victims. On either side of the mandibles is a six-jointed palp, shaped like the legs, which, besides other uses, serves to hold and turn the prey when swathing it or feeding upon it. The eight legs are attached to the cephalo-thorax, are seven-jointed, covered with spines, bristles and hairs, the tarsal joint ending in a foot having two or three claws constructed for grasping and handling delicate threads. The second main part of the spider's body is the abdomen, which while generally ovate greatly varies in form; being globular, subtriangular, cylindrical; sometimes flat, sometimes convex above. The ventral surface is flat or slightly converse. The integument is commonly soft, but sometimes leathery; in many species it is hairy; in others nearly naked and glossy; in some bordered with sharp, hard, spinous processes or conical tubercles at the base, which for the most part overhangs the cephalo-thorax. The pedicle or stem uniting these two principal parts of the body is a short cartilaginous tube through which pass the organs of nutrition and circulation. This partial description, with the accompanying figures, will give a sufficient general idea of the structure and appearance of the most common species.



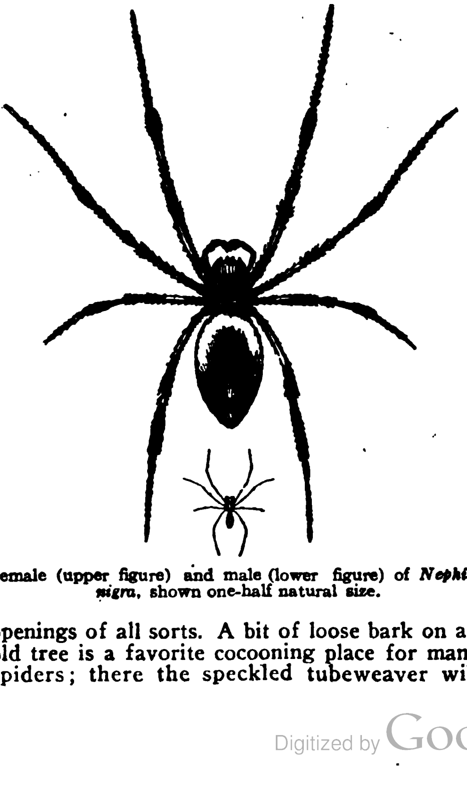
Ventral view of *Argiope argyraspis*. ps, palps; mx, maxilla ax, cu, hu, ra, dg, the auxillary, cubital, humeral, radial, digital, joints of palpi; sm, sternum; cx, coxa of the leg; gl, breathing gills; ep, epyginum; sp, spinnerets, shown closed; ac, anal closure.

The mature male is most readily distinguished from the female by the bulbous shape of the terminal joints of the palps, which often assume involved forms that serve as good specific characters. Some times, as in certain orbweavers, the male is so much smaller than his mate that the disparity seems ridiculous. Wooing under such conditions is a serious undertaking. One will see several diminutive courtiers in attendance at the outer courts of the snare of our native species, the orange and the silvery Argiope (*A. aurantium*, *A. argyraspis*); and not infrequently dead and juiceless skeletons may be seen hung up thereto in silken swathments, like scalps upon a savage's wigwam.

Habits.— Gravid females differ largely in their modes of caring for their eggs and young. Most species enclose the eggs in a silken sac, which is protected in various ways. Orange Argiope spins a large pyriform cocoon with a tough, nearly waterproof case, lined inside with yellow floss, which encloses an ovate mass of brown silk, within which are the eggs numbering as high as a thousand or more. This is hung upon bushes, stayed and surrounded by sundry braces and cross-lines. The labyrinth spider (*Epeira labyrinthea*) puts her eggs into several silken discs strung together in a bead-like row, which is swung within the thick maze that surrounds the leaf-thatched domicile that overhangs her orb. Many orbweavers spin their cocoons in angles of cornices, under bark, in cracks and crevices, knot-holes and sheltered openings of all sorts. A bit of loose bark on an old tree is a favorite cocooning place for many spiders; there the speckled tubeweaver will

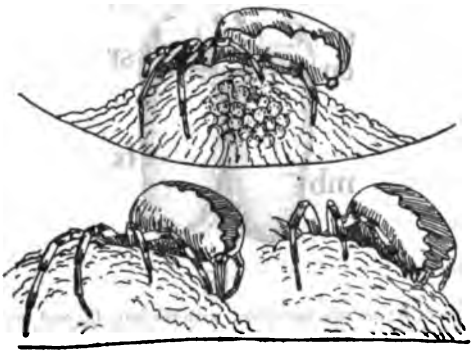


Face of *Epeira* mb, mandibles, with the falx, fx, and fangs, fg; es, eye space; v, vertex; cp, clypeus; MR, mid-rear eyes; SR, side-rear; MF, mid-front; SF, side-front.



Female (upper figure) and male (lower figure) of *Nephila nigra*, shown one-half natural size.

often deposit her eggs within several wraps of silk, all overlaid with bark pellets gnawed from the tree. Some of our familiar lineweavers, as *Theridium tepidariorum*, put their eggs into several brown sacs which they keep near them within their netted cobwebs, on which the spiderlings hang when they are hatched. Many tubeweavers and laterigrades spin a tough disc, white, gray, mottled or pinkish, against various surfaces, especially on or under stones. Most species die shortly after cocooning and the young are left to the nurture of nature. Others have some sort of care over the spiderlings when they appear and until they leave the home bounds. Among ground-spiders (*Lycosidæ*) one notes the interesting habit of tying the round egg-bag to the spinnerets and carrying it around until the younglings come out, when they mount the mother's back and are borne around clinging thereto until they disperse. A mother with a hundred babies piled upon her body as she runs over the ground is a grotesque spectacle; but the oddity vanishes in the light of mother-love. At least one species, the European water-spider, cocoons under water within her diving-bell-like domicile. This is but a glance at the varied forms which maternal instinct takes among spiders to perpetuate the race.



(a) *Epeira strix* spinning her egg-cocoon. (b) The inner covering of the egg-mass. (c) Overlaying the thick outer covering.

Beneficial Uses.— One needs to give good heed who would know how large a part spiders have in the economy of nature. They are among the most numerous of our fellow-tenants of the earth. A fair idea of the myriads that live near us may be had on a dewy morning of late summer or early autumn. Glancing over the fields and along the country roadsides one will see their webs, disclosed by the minute beads of mist caught by the delicate threads, literally covering the low herbage. Turning the eyes to bushes and trees, the branches, twigs and leaves are seen to be meshed with spinning work. In short, the whole landscape is overspread with the tents and meshes of the aranean hosts. Other hosts could be found by raking amid fallen leaves and earth-litter and searching beneath stones, logs and rubbish, in hollow trees, post-holes and crannies, under ledges and along the water side. There is scarcely a spot, indeed, where some species of spider may not be found. The problem of commissary supplies for this innumerable army is an important one, and its consideration opens up a strange contradictory phase of human nature, or perhaps one should say of human ignorance.

The popular prejudice against spiders has been so long fixed that it is hard to overcome it, but is yielding before the better knowledge of natural objects and sympathy therewith that now prevail. The prejudice is perhaps largely due to erroneous views of their ugliness and dangerousness. The species frequenting cellars and outhouses are dark colored and at first glance somewhat ungainly. But to judge the race by these would lead one as far astray as to judge all birds by buzzards and crows. In truth, some spider species rival butterflies and beetles in brilliancy of color. And these are not tropical forms alone, but are among our indigenous species and may be found in most parts of America by searching fields, bushes, bosky brook-sides, the edges of woods and open places therein. Delicate greens, pink, ruby, scarlet, orange, yellow, brown, gray and metallic hues, silver and green especially, abound, and give remarkable beauty to the outer robing of our native fauna. Exotic species are even more brilliant.

Yet more erroneous is the popular view of the spider's noxious and injurious character. That a few species may and occasionally do inflict a wound that may cause suffering and under peculiar conditions even death is doubtless true; although it is nearly impossible to verify current reports of injury and death caused by a so-called "black spider," which, as it commonly turns out, had simply been seen somewhere near the victim. That insects inflict wounds which may be serious under certain unfavorable conditions is well known, and the possibilities for great damage to the human family by flies and mosquitoes is now established. But spiders may be ranked among the least dangerous to man of the small and most familiar invertebrates. The writer has been struck by large lycosids (ground-spiders) and has compelled one of our largest orbweavers to wound him, without more serious consequences than the prick of a pin. A mosquito's puncture, on the contrary, causes a painful hurt, with an inflamed area the bigness of a silver dollar surrounding the central white swelling. This will show that personal idiosyncrasies are factors in the danger to man of a spider wound,

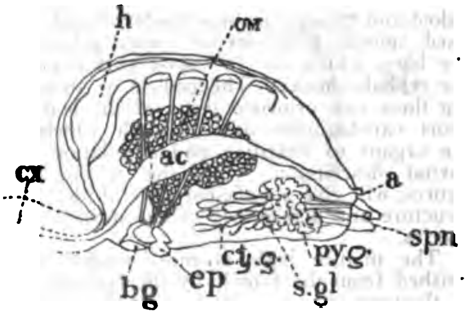


Diagram showing location of spinning organs in the abdomen of an orbweaving spider. spn, spinnerets; s. gl, silk glands; py. g, pyriform; cy. g, cylindriform, and others which connect by delicate ducts with the outer spinning-spools; cx, cephalo thorax; h, heart; ov, ovaries; ac, alimentary canal and its termination, a; bg, breathing gills; ep, epigynum and oviduct.

as of an insect's. Admitting the worst, however, the credit side of the spider account is so large that the reverse is scarcely worth mention. Insects are known to be serviceable in the fertilization of many plants. The bee has been domesticated for the edible product of her cells and the silkworm for its cocoon fibre. But beyond these and a few other exceptions the insect hordes are among our most destructive domestic foes. Farm, garden, orchard and plantation can be profitable only by vigilant and unremitting warfare upon these destroyers whose inroads cost the nation hundreds of millions yearly. But spiders injure no food-plant or other product of human industry. In fields and groves, orchards and outhouses they are not only absolutely innocuous, but are engaged in ceaseless warfare upon the enemies of man's prosperity, comfort and health. Their chief food is insects, and day and night they pursue that function which nature has assigned them and keep in check the myriads of insects that otherwise would overwhelm us. It is doubtful if civilized man could successfully cultivate or even inhabit the earth, if it were not for these despised benefactors, unless nature were to provide some other agency to hold even the balance of helpful and harmful life. Even when spiders enter our homes and spin their cobwebs in our porches, halls and chambers, they come upon the wholesome errand of clearing our premises of irritating and dangerous guests. It is pitiful that these benefactors of our race should be the subjects of unsparing obloquy and hate and should be slain at sight without compunction.

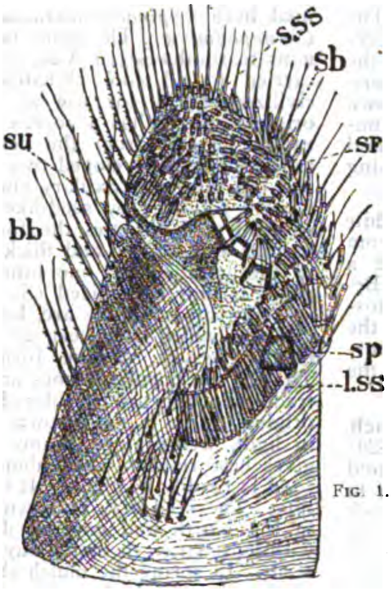


FIG. 1.

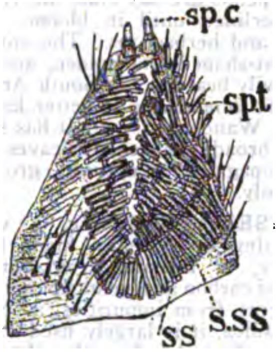


FIG. 2

FIG. 1 —A posterior spinneret of *Epeira*. sp, spigot-spool; l. ss long spinning spools; s. ss, short spools; bb, branched bristles; sb, simple bristles which aid in spinning.
FIG. 2.—A middle spinneret of *Epeira*, sp. c. spigot-spool discharging cylindrical gland; ss ands. ss, spools of pyriform gland; sp. t, of treeform gland.

Bibliography.— The literature of spiders is too abundant to be here cited; but from several American works the student may obtain needed help. Among them are 'Spiders of the United States' by Professor Hentz, the father of American araneology; Dr. McCook's 'American Spiders and their Spinningwork,' 3 vols., folio, profusely illustrates structure and habits and gives classification of Orbweavers: the studies by Prof. Geo. W. and Mrs. Elizabeth G. Peckham of general habits are most interesting and their work on the 'Attidæ' is quite complete; 'The Common Spiders of the United States' by J. H. Emerton is a good popular treatise; 'Catalogue of the Described Araneæ of Temperate North America,' by the late Dr. George Marx of the Smithsonian Institution, is valuable; Nathan Banks of the National Museum, Washington, has written some important papers, as also has Prof. Thos. Montgomery of the University of Texas, Austin. Among foreign works one should know the 'Histoire Naturelle des Araignees' of M. Eugene Simon. Among British authorities consult 'Blackwell's Spiders of Great Britain and Ireland' and the works of Dr. Pickard. Emerton, J. H., 'The Common Spiders of the United States' (Boston 1902); Fabre, J. H. C., 'The Life of the Spider' (New York 1913); Keyserling, E., Graf, 'Die Spinnen Amerikas' (Vol. IV, Nürnberg 1892); McCook, H. C., 'American Spiders and their Spinning Work' (3 vols., Philadelphia 1889–93); Petrunkevitch, A., 'A Synonymic Index Catalogue of Spiders of North, Central and South America, etc.' (in American Museum of Natural History Bulletins, Vol. XXIX, New York 1911); Warburton, C., 'Spiders' (Cambridge 1912).

HENRY C. MCCOOK,
Author 'American Spiders and Their Spinning Work.'

SPIDERWORT, any plant of the genus *Tradescantia*, or (by extension) of the family *Commelinacaæ*. The spiderworts are perennial, succulent, somewhat mucilaginous herbs, having linear or lanceolate leaves and showy reddish or blue flowers in umbel-like cymes, subtended by bracts. *Tradescantia virginiana* is a species native to the Middle Atlantic States, but often found farther north in cultivation or escaped from gardens. It has stems often in clusters and about a foot high; the leaves very narrow, either glabrous or slightly pubescent, as long as the stem and of a bright green color. The large corollas of three petals are sky-blue, the villous pedicels being declined until in bloom. The sepals are broad and herbaceous. The anthers are large, crescent-shaped and golden, and the filaments are heavily bearded. A South American spiderwort, *T. fluminensis*, is better known under the title of Wandering Jew. It has similar flowers and broadly lanceolate leaves and is very easily propagated by cuttings, growing often in water only.

SPIEGELEISEN, spē'g'l-ī"zĕn, a white cast iron originating in Germany, made from specular iron ore, or hematite, containing a large percentage of carbon and manganese. Being remarkably free from impurities, as phosphorus, sulphur, silica, it is largely used in the Bessemer process of steel-making for the purpose of reintroducing carbon. It reduces the iron oxide and is itself subject to oxidation.

SPIELHAGEN, spēl'hä"gĕn, **Friedrich,** German author: b. Magdeburg, 24 Feb. 1829; d. 1911. He studied at Berlin, Bonn and Greifswald, turned from an academic career to literature, made some translations from French and English, including one of ‘Amerikanische Gedichte’ (1856; 3d ed., 1871), and after publishing two sketches that attracted little attention, became well known through his ‘Problematische Naturen’ (1860), in which he advocated the advanced liberal politics of his time. His ‘Sturmflut’ (1876), based on the financial crises in Berlin following the Franco-Prussian War, is worthy of comparison with this. He wrote a great number of optimistic and sometimes extravagant novels, having a preference for social problems. His books are often truly voluminous and frequently somewhat grandiose, but display a certain energy of treatment in dealing with what the author believed important questions of the time. See Problematische Naturen.

SPIERS, spērz, **Richard Phené,** English architect and archæologist: b. 1841. He was educated at King's College, London, and the Ecole des Beaux Arts, Paris, and is master of the Architectural School and surveyor of the Royal Academy. In addition to editing Pugin's ‘Normandy’ (1870) and Fergusson's ‘History of Architecture’ (1863), he has written ‘Architectural Drawing’ (1887); ‘The Orders of Architecture’ (1902); ‘Architectural Essays on Sassanian Architecture’; ‘Domed Churches in Perigord’; ‘Architecture, East and West,’ etc.

SPIGELIA, spī-jē'lĭ-a, a genus of annual and perennial herbs of the order *Loganiaceæ*, of which about 35 species are American. They have opposite, membranous leaves and terminal spikes of yellow, red or purplish flowers. The best-known one, pink-root or worm-grass (*S. marilandica*), is native from New Jersey to Wisconsin and southward to the Gulf States. It is valued in hardy garden borders because of its handsome, red, tubular, yellow-throated flowers which appear during mid-summer and also because of its easy culture in rich, friable, loamy soils. It roots have been used medicinally.

SPIKENARD, a North American herb. See Aralia.

SPINA BIFIDA, cleft spine. See Tumor.

SPINACH, spĭn'āj, or **SPINAGE,** an annual herb (*Spinacia oleracea*) of the family *Chenopodiaceæ*. The plant is probably indigenous to southwestern Asia, whence it has been carried to all cool climates throughout the civilized world for use as a potherb. The original species has a rosette of arrow-shaped radical leaves, from the centre of which a flower-stalk is developed two to three feet tall and bearing small axillary clusters of diœcious flowers followed by seed-like fruits (akenes). In cultivated varieties the form of the leaf is various and its size and thickness greater than in the wild. Only one other species of the genus is now recognized (*S. tetrandra*) but is not cultivated. There are, however, groups of varieties which have been given specific names mainly because of the form of the fruits. Though the popular names are retained in the trade the plants are considered one species. The original form is not known. Spinach thrives in light, well-drained, loamy soils and always gives best returns when abundant nitrogenous food is readily available. It is easy of cultivation. The seed may be sown in early autumn in the North and covered during the winter with loose straw or marsh hay, free from weed-seeds. In spring the mulch should be removed very early. Early spring sowing may be done but, since the plants produce smaller, fewer and poorer leaves, and are prone to develop a seed-stalk at the approach of warm weather, the planting season in spring must be curtailed. About eight weeks usually elapse between sowing and gathering the plants except when the crop is wintered. In field practice spinach is usually sown in beds about 10 feet wide made by plowing several furrows toward a centre and leaving dead furrows between the beds for surface drainage. The seeds are sown in drills about 15 inches apart and the ground kept cleanly cultivated. Since the crop is of short duration it is generally used prior to or after summer-maturing crops. It is, however, also frequently sown between the rows of other crops. Immense quantities of spinach are grown in the South, especially upon the Atlantic seaboard for the Northern markets, and except for home use the cultivation of the crop under cold frames is now little practised in the North. The plants are gathered when dry with some of the root attached, trimmed of dead leaves and shipped in tightly packed barrels or crates.

SPINAL CORD, the posterior or inferior portion of the cerebro-spinal axis, entirely located in the spinal canal. In those animals which stand upright it may be termed the lower portion. The spinal cord is directly continuous with the medulla oblongata (q.v.) and, varying with different animals, it extends practically the length of the spinal canal, giving off numerous paired spinal nerves (q.v.) and terminates by breaking up into a series of terminal nerves, the so-called cauda equina. With reference to its length and thickness, its divisions and arrangements, both internal and external, considerable variation exists in different animals. (See ANATOMY, COMPARATIVE). In man, however, the spinal cord comprises all that portion which lies between the cauda equina and the decussation of the pyramids in the medulla. It lies within the bony framework of the spine, covered on the outside by a thick membrane, the dura mater, which is continuous with the dura mater of the brain. Within this is a thin delicate layer of tissue, the pia mater, which covers the cord closely, being continuous with the pia mater of the brain. Between the dura and pia a certain amount of cerebro-spinal fluid is found, which serves as a protection-sheath. Passing out and coming into the cord are the paired motor and sensory nerves that carry motor impulses to all the muscles of the body below the head and sensory impulses to the brain from all the sense organs of the skin, mucous membranes and viscera. In simple language it is a large cable which carries incoming and outgoing messages. The incoming messages come through various organs of sense, the stimuli come in through receptors, they then travel in nerve fibres, enter the cord, form connections, etc., with the brain or other nervous centrals and outgoing messages travel down to make effective action in the environment. The general shape of the spinal cord is cylindrical. It is slightly flattened front and back and tapers at its caudal end into a long thin strip, the filum terminale. In its course it shows two enlargements, the cervical and dorsal enlargements, corresponding to the location of increased amounts of nervous tissue that go and come from the upper and lower extremities. The length of the cord proper, apart from its terminal filament, averages only about 18 inches; it, therefore, falls short several inches of filling the entire spinal canal. It is about one-half inch in width at the widest part and weighs in an average adult about one pound. The spinal cord is nothing but a collection of nerve ganglia and nerve-fibres, but in the human cord these are not as simple in their arrangement as in the nervous cords of insects, for instance. The cord preserves its bilateral symmetry, but its metameric symmetry is much modified, particularly in its internal structure. Thus the spinal cord consists of nerve-cells and nerve-fibres, like all other parts of the nervous system. It is divided almost into two halves by deep fissures in front and behind; and there are several secondary fissures that further subdivide the cord into segments corresponding somewhat to its anatomical arrangement. In order to understand somewhat of this anatomical arrangement it is important first to trace the different fibre-tracts that go up and down the spinal cord and which make up its white matter. The first nerve-fibres to develop are sensory. These collect into bundles and, through the posterior spinous processes, pass into the cord and constitute two bundles of fibres, the columns of Gall and the columns of Burdach. These columns are at first very small, but as they continue to receive more and more fibres passing upward they become larger. After their entrance into the cord the sensory fibres give off many collaterals, making extremely complicated anatomical connections with the different segments of the cord. One set of these collaterals, however, makes a distinct bundle of fibres, which has been called the column of Gowers, or ascending lateral tract. All three of these fibre-tracts carry sensory impressions from the surface of the body to the brain; they constitute the sensory neuron-paths. The column of Gowers is known to carry pain-sensory stimuli. These sensory neuron-paths terminate in the sensory areas (q.v.) in the brain, having numerous interruptions or stations, on the way up. The typical sensory neuron-path is made up of three or four of these stations. The first ganglionic centre is in the posterior ganglia; the second is in the medulla, constituting the nuclei of the columns of Gall and Burdach; the third is in the optic thalamus and the fourth is in the cortex of the brain. As to the part of the cortex, it varies according to the character of the incoming stimuli: gravity stimuli are mostly located in the cerebellum, sight stimuli in the occipital lobes, sound stimuli in the temporal lobes, where the sensations for liver, spleen, kidney, heart, etc., are, is still under discussion. Passing down from the brain a large number of motor tracts make up the larger part of the remaining white matter of the cord. The most important of these bundles are the direct and indirect or crossed pyramidal tracts. The descending anterolateral tract and direct cerebellar tract are other smaller fibre-masses. Still other minute fibre-bundles are found in the cord, but their description belongs to more extensive treatises. The main function of these descending tracts is to carry motor impulses down from the motor area to the gray masses of nuclei located on the interior of the spinal cord. From these spinal centres the impulses are transmitted to the motor nerves which pass out the entire length of the cord, from in front, where they later bend backward and join the sensory fibres and together form mixed nerve-trunks. The motor nerves finally terminate in the muscles by specially modified muscle-plates. As the nuclei of the columns of Gall and Burdach in the medulla were the first ganglionic terminals of the sensory neuron-chains, so the gray masses in the anterior columns of the cord are the first ganglionic terminals of the motor neuron-chain. If the spinal cord be cut across, these ganglionic masses appear on the cut surface as a gray letter H, or as a butterfly-wing, according to the region where the cut is made. In these wings certain definite groups of ganglion-cells may be made out, running short distances in and down the spine. These constitute definite ganglionic centres for certain muscle-groups, and their destruction causes the well-known spinal paralysis of children. Throughout the entire length of the spinal cord there is a small cavity around which there are bridges of fibres connecting the two halves of the cord. Thus the spinal cord is seen to represent a mass of cells and fibres, of vastly complicated structure, and subserving all of the nervous functions of the muscles of the skeleton and of the viscera below the diaphragm, save the stomach. The spinal cord is in intimate connection throughout its entire length with the sympathetic nervous system. Any interruption in the spinal cord interferes with the carrying capacity of its fibres and cells. There then results disease of the spinal cord the symptoms of which will differ according to the place where the interruption takes place. As the pathways of the different kinds of sensation messages and motion messages are extremely complex they cannot all be spoken of here. Only some of the more striking types of loss will be spoken of. If the entire cord is cut across, as happens in broken back from diving into shallow water, from bullet wounds of war, or sometimes from a tumor of the spinal cord, or an inflammation, there results a paralysis of all motion below the place where the injury takes place. If in the upper neck region the paralysis is of the entire body below the neck. If the injury is lower down the lower extremities alone are involved with such portions of the trunk as lie below the site of the injury. All above the site of the lesion is a loss of sensation. This would naturally follow from what has been said that the pathways are carrying sensory messages up and motor messages down. An incomplete section of the spinal cord introduces a number of complicated results which only the nervous specialist can analyze. He is like a telephone expert. He is a trouble hunter on the line and from the symptoms which the patient shows he is able to accurately locate the place where the interruptions are occurring or have occurred.

In some disease processes localized parts of the spinal cord are picked out by the process and a limited type of injury takes place. Thus in the disease known as infantile paralysis [poliomyelitis] the virus of the disease chiefly involves the connections of the motor pathways as they make a switchboard connection with the muscle groups in the anterior horns of the spinal cord. This results in a partial or complete paralysis of one or more groups of muscles. Sometimes the sensory parts of the cord are cut off or diseased. This cuts off information from switchboard operators higher up and various types of loss of feeling, inability to localize, inability to know what one is doing with one's muscles, etc., results. A great number of complicated troubles can result and bring about the clinical pictures called syndromes, in neurology, such as locomotor ataxia, syringomyelia, multiple sclerosis, paraplegia, muscular atrophies, etc., which must be consulted in a work on diseases of the spinal cord or diseases of the nervous system. Consult Barker, 'Nervous System' (1901); Dejerine, 'Anatomie du Systeme Nerveux' (1901–04); Van Gehuchten, 'Systeme Nerveux' (1903); Spalteholz, 'Anatomy Atlas' (1904); Winkler, 'Manual de Neurologie'; Jelliffe and White, 'Diseases of the Nervous System' (3d ed., 1919). See BRAIN; NERVOUS SYSTEM, EVOLUTION OF THE; REFLEX ACTION.

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SPINAL CORD SURGERY. The surgery of the spinal cord has been much advanced during the last decade and at the present time clear indications exist for operative interference. In injuries of the spinal cord due to fracture of the vertebra or bullet or high explosive wounds, operative interference should be done only if the spinal cord has not been completely crushed. If the X-ray gives evidence of pressure on the cord from fractured bone or foreign bodies, a laminectomy should be performed. If there is doubt as to whether the lesion is a complete one, i.e., involving the complete thickness of the cord, the patient should be watched for symptoms to give evidence that part of the cord is still functionizing. Spinal cord surgery has had its greatest triumphs in the removal of tumors pressing upon the cord, and if the condition is recognized early the patients can be entirely relieved of their symptoms. Inflammatory diseases of the spinal cord sometimes demand operative interference, especially in those cases in which the disease is slowly progressing and at a definite level of the cord. Operations upon the spinal cord are sometimes required for the condition of the nerve roots. The technic of spinal operations has been much simplified. In the large majority of instances, in otherwise healthy individuals, the dangers of operation are very small. In the operation, known as laminectomy, the spinal canal is opened by the removal of its posterior wall, that is, by the removal of the spinous processes and laminæ forming together a posterior arch of each vertebra. The functions of the vertebral column are fully regained after spinal operations. The mortality of the spinal operation itself, in otherwise healthy individuals, should be no more than 5 per cent, which is a small mortality for a major operation of this kind.

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SPINAL NERVES, the paired nerves which arise from and pass into the spinal cord (q.v.), and which are distributed to the various muscles of the body and come from the various sense-organs, skin, intestines, bladder, etc. The spinal nerves are so named in contradistinction to the cranial nerves, or those which originate from or pass into the brain itself. From the spinal cord of man 31 pairs of spinal nerves arise. They pass from and enter into the spinal cord and spine through the intervertebral foramina, or openings between the bodies of the vertebræ, the motor part of the nerve passing out in front, the sensory part coming in from behind. Eight pairs are cervical; 12 are dorsal nerves, also named thoracic; five are lumbar, five sacral and one coccygeal. Each spinal nerve is formed from two portions, an anterior or motor, and a posterior or sensory. The posterior root has a nerve-mass or ganglion, which is wanting in the anterior. The fibres of the anterior roots are motor in nature; that is to say, impulses travel by these roots outward from the cord or brain to the body. The fibres of the posterior roots are sensory: impulses are conveyed by these fibres to the cord or brain. The anterior and posterior fibres unite just beyond the nervous ganglion to form a single nerve-trunk, in which the two sets of fibres are indistinguishable. See ANATOMY; BRAIN; NERVOUS SYSTEM, EVOLUTION OF THE; SPINAL CORD.

SPINDLE-TREE, a name originally applied to an European species of *Euonymus,* shrubs belonging to the *Celastraceæ.* The

American species have more or less four-angled and winged stems, with petioled entire or serrate leaves and regular, perfect four to five-merous flowers in axillary cymes. They open in early summer and are small and inconspicuous and greenish or purplish in color; they are succeeded, however, by very brilliant fruits or pods, which are several-celled, lobed or angled and which, when mature, open, showing the somewhat fleshy red arils which have grown up from the base of the seeds and now enclose them. The fruits remain on the tree during the winter, so that these shrubs are often cultivated in ornamental shrubbery. *E. europœus* is called spindle-tree, because its hard, close-grained, white wood was once esteemed as a material for spindles, musical instruments and netting needles and is still used for skewers and in turning. It is a glabrous shrub, with broad and shining leaves and deeply four-lobed, smooth pods which have been employed as a dye-stuff. One of our most handsome shrubs in autumn is the burning bush, or wahoo, *E. atropurpueus*, with crimson and scarlet lobed capsuels. *E. americanus* is the strawberry-tree, a low bush, with oval leaves and a crimson capsule, scarcely lobed, but covered with pointed warts and disclosing scarlet arils. The *E. obovatus* is similar in fruit, but has a trailing habit and obovate leaves The foliage of a Japanese species (*E. alata*) turns to a brilliant rose pink in autumn.

SPINE, the backbone of a vertebrated animal. See ANATOMY; OSTEOLOGY; SPINE, PATHOLOGICAL CHANGES IN; TUBERCULOSIS.

SPINE, Pathological Changes in. The odontoid process of the axis of the spine presents two articulating surfaces, one in front, of an oval form, for articulating with the atlas, and another for the transverse ligament, the latter frequently encroaching on the sides of the process. Serious displacement at this point of articulation causes instant death, due to pressure and injury of the cord and nerve-trunks. The vertebral column quite frequently sustains fracture from an indirect violence which tends to produce overexertion on one flexion of its normal curvature. Tuberculosis of the vertebral articulations or Pott's disease is an affection of the spine. At birth there are no curves in the infant's spine, but as the child assumes the sitting or erect posture, curves which are recognized as the normal vertebral curves are developed. Weak muscles, careless postures and paralysis of special groups of spinal muscles are causes of spinal curvature. Scoliosis is lateral curvature, that is, with the convexity of the curve to one side. Cyphosis, or humpback, is the form in which the convexity of the column is increased in a posterior direction. Lordosis, or hollow-back, is a spinal deviation in which the convexity of the curve is forward. In old age the spine is apt to shorten owing to shrinking of the gristly formation between the vertebræ. Inflammation of the cord rarely gives rise to pus, but a few cases have been described. The suppuration is necessarily micro-organismal in origin and as a rule it is either due to some septicæmia or traumatism, or secondary to purulent meningitis. The spinal cord (q.v.) is influenced by diseased conditions of other parts of the body. It is the centre for all the degenerative disorders of the nervous system, such as locomotor ataxia, degenerative spastic paraplegia, primary lateral sclerosis, etc. The chiropractics have made special study of the spine and the nerves passing through its articulations. See CHIROPRACTIC.

SPINE-FOOT, a genus of lizards (*Acanthodactylus*), so named from the spinous appearance of the toes, which are «keeled» beneath and possess fringed edges. A familiar brown species (*A. vulgaris*) occurs from Spain and Morocco eastward to northern India.

SPINEL, an isometric mineral of many colors, almost always in octahedral or dodecahedral crystals. Octahedral twins are so common as to give the name «spinel twin» to this form (see explanation under MINERALOGY). It is characterized by a hardness of 8, which is exceeded by only three minerals, diamond, corundum and chrysoberyl, and is equaled by but a few. It is brittle; fracture conchoidal; specific gravity, 3.5 to 4.1; lustre vitreous; streak white; transparent to nearly opaque. Essentially it is a magnesium aluminate or a compound of the oxides of magnesium and aluminum, these metals being at times in part replaced by iron and, in the variety picotite, also by chromium. The varieties are distinguished by differences both in color and composition. The red variety is often transparent and is known as ruby spinel (q.v.) or balas ruby. Rubicelle is yellow or orange-red; ceylonite or pleonaste is dark-green, brown or black and nearly opaque; chlorospinel is grass-green. Blue and yellow varieties are also found and sometimes yield choice gems. Its most noteworthy occurrences are in the gem gravels of Ceylon, Burma and Siam, in the ejected blocks of Vesuvius and in the limestone belt of Orange County, N. Y., and Sussex County, N. J.

SPINEL GROUP, an important group of isometric minerals, usually included among the oxides, though chemically they are oxygen salts. The group embraces the closely related aluminates, spinel, hercynite and gahnite; the ferrates and manganates, magnetite, magnesioferrite, franklinite and jacobsite; and the metachromite, chromite. Their general formula is $R''R'''_2O_4$.

SPINELLO, spē-nĕl'lō, **Di Luca** (called SPINELLO, ARETINO), Italian painter: b. Arezzo, 1333; d. there, 1410. His principal frescoes were done for the sacristy of the church of Saint Miniatus near Florence, for buildings at Pisa, Siena, Arezzo and for the municipal buildings of Sienna (a series illustrating the Italian wars of Frederick Barbarossa). Spinello enjoyed a great reputation in his own day, being compared, and by some preferred, to Giotto, whose style his own in some respects resembles. His ‹Virgin and Child› sold in 1889 for $3,725.

SPINET, a stringed instrument invented about 1490, formerly much in use, but now superseded by the pianoforte. It was somewhat similar to the harpsichord, and like that consisted of a case, sounding-board, keys, jacks and a bridge. The spinet was smaller than the harpsichord and contained two or three sets of jacks (small oblong slips of wood, with crow-quills attached for striking) and strings so disposed and tuned as to admit of a variety of stops, while the former had only one set of jacks and strings and consequently only one stop. See PIANOFORTE.

SPINGARN, Joel Elias, American educator: b. New York, 17 May 1875. He was graduated from Columbia University in 1895, became an instructor and in 1909 was professor of comparative literature; has published 'A History of Literary Criticism in the Renaissance' (1899); 'The New Criticism' (1911); and other works of literary criticism.

SPINIFEX, or **PORCUPINE GRASS,** a perennial grass (*Triodia irritans*) which grows on otherwise barren dry ground in Australia, forming tussocks through which horses and men find difficulty in progressing because of the uncertain footing and because the spiny edges of the hard leaves cut the clothing or feet.

SPINNER, Francis Elias, American financier: b. German Flats (now Mohawk), N. Y., 21 Jan. 1802; d. Jacksonville, Fla., 31 Dec. 1890. He was apprenticed to a confectioner and then to a saddler, but in 1824 became a merchant at Herkimer, N. Y. He was deputy sheriff of Herkimer County in 1829–34, sheriff in 1835–37, was active in the militia where he gained the rank of major-general and in 1838–39 was State commissioner for building the State lunatic asylum at Utica. He was connected with a bank in Mohawk for 20 years as cashier and as president, was auditor and deputy naval officer in the naval office at New York in 1845–49, and in 1855–57 was a Democratic member of Congress. He was one of the original members of the Republican party, was re-elected by it to Congress in 1856 and in 1858, and was appointed United States treasurer by President Lincoln in 1861, a post which he occupied until 1875. He was the first to suggest the employment of women in the government offices and carried his point, though against much opposition. His name became during his long term of office the synonym of integrity and his designedly singular signature on the "greenbacks" of the United States was the most familiar autograph in the country.

SPINNING, the process of twisting into fine threads of uniform size fibres of cotton, flax, wool or other fibres for weaving purposes. The process was performed by hand from early Egyptian times with the distaff and spindle, the distaff being a stick or staff on which a mass of carded raw material called a roving was loosely bound and the spindle being a smaller round stick, usually weighted, to which the thread was attached and with which it was twirled into a thread or yarn by adroit manipulation. The art of spinning thus came to include two distinct operations: the drawing out and evening the fibre which was to form the thread; and the twisting of it. In hand-weaving the first was done by the fingers of the left hand; the second by the right hand.

The spinning-wheel to revolve the spindle, attached to its frame, was an improvement on the manual method, introduced from India into Europe during the 14th century and thence to America in the 17th century. Its use did not begin to be displaced until the middle of the 18th century, and it was still to be seen in operation at the beginning of the last quarter of the 19th century, in many provincial places untouched by railways, throughout Europe and other parts of the world. The operation usually performed by young women gave rise among English-speaking people to the word "spinster."

The India wheel was comparatively large and the operator stood at her work, walking away and back as the forming of the thread seemed to requre. A wool-spinner working continuously would thus travel 20 miles a day. The next development was the "Saxony wheel" or flax wheel, invented in Nuremburg about 1530. This wheel was much smaller in diameter and operated by a treadle, the spinner sitting at her work. The driving-cord of the Saxony wheel was in two loops, one passing around the pulley of the spindle and the other around the pulley of a bobbin or reel on which the yarn was wound as it was spun. Later two spindles were in use on the Saxony wheel by expert spinners, who thus doubled the usual amount of thread in a given time. With the improvement of the loom, so that its output was quadrupled, the demand for yarns was suddenly increased beyond the capacity of the hand spinners. Invention was thus stimulated and in 1738 two spinners, John Wyatt and Lewis Paul, devised and patented a method of drawing out and evening the fibre preparatory to twisting, by means of rollers revolving upon one another. For some unexplained reason this mechanism failed to come into popular use in the spinning trade until 30 years later, when the idea was adopted by Richard Arkwright and embodied in his throstle machine. In quick succession, at the beginning of the last third of the 18th century appeared Hargreave's spinning jenny, an improvement on the double-thread producing Saxon wheel; Arkwright's throstle machine, or roll-drawing spinning machine; and Crompton's mule-spinner, three inventions which revolutionized the art of spinning. Although many important improvements have been made since in constructive details, the general priciples of all modern spinning machinery are those of these three inventions.

The spinning jenny invented by James Hargreave's in 1767, in its simplest form, resembled a number of spindles turned by a common wheel or drum which was worked by hand. It stretched out the threads as in common spinning of carded cotton, eight at a time, but this was soon improved upon and with the application of power as many as 80 could be spun as easily. The drawing was done by a movable carriage on a track which simulated the movement of the walking spinner at the India wheel.

The throstle or roll-drawing spinning machine, patented by Arkwright in 1769, accomplished its object, the drawing of the rovings, through the action of successive pairs of rollers, each pair in advance of the others and moving at different rates of speed. The first pair to receive the sliver compressed it and passed it to the second pair, which revolved at a greater speed and thus pulled it out to exactly the number of times greater length that their revolutions exceeded those of the other pair. As the roving issued through the last rollers of each machine, it was received on spools or reels, calculated to hold a given quantity; and these were transferred to the spinning-frames, which resembled the roving-frames. As the roving unwound from the but his conception is very different from the ordinary theological one. In the first place the world is not regarded as dependent on the will of God, but as the necessary result of his nature or essence. Everything necessarily follows from the nature of God, just as the properties of the triangle or circle follow, from the nature of these figures. The bond which necessarily unites all of the parts of the universe to the common centre or substance, and thus to each other, is not causal in the usual sense of that relation, but rather logical. God is the underlying ground from whose nature or essence all things proceed in a regular and uniform order. God does not act as a man acts by setting plans or purposes before himself and then proceeding to realize them, nor has he emotions or passions like men which move him now in this direction and now in that. Spinoza satirizes unsparingly the external teleology and anthropomorphism of his day which sought to explain the course of natural events by referring them to special ends and purposes on the part of God. For Spinoza, God is not transcendent, existing apart from nature, but nature itself as an active self-determining process (*natura naturans*) is God. The one infinite substance, or God, has an infinite number of attributes, but it is known to us solely through the two attributes of extension and thought. Thus every physical thing is a mode of extension, and every idea a mode of the attribute of thought. The physical and the psychical are not independent substances, as Descartes supposed, nor is there any interaction between them. The truth is, that physical things and thoughts are modes which express the nature of the one substance, but each side expresses this nature in terms of a different attribute. Yet though there is no interaction there is an exact correspondence between the modes of extension and the modes of thought: «the order and connection of ideas is the same as the order and connection of things.» This is Spinoza's statement of the Parallelism (q.v.) of mind and body, a doctrine which he was the first to maintain. He develops this theory in some detail, defining the mind as the «idea of the body,» and emphasizing the correlation between the perfection and development of the body and the effectiveness and sanity of the mind.

It is with the problem of man's place in nature — his relation to God or the total system of things, and the possibility of his freedom — that Spinoza is most directly concerned. Here he shows that the possibility of man's freedom depends upon his first recognizing that he is a part of nature, and that his mind, like everything else, is subject to uniform natural laws. Man forms no «kingdom within a kingdom»; it is not contingency or some strange power of free will which governs his mental experiences; but here as elsewhere all takes place according to law and necessity. «Nature's laws and ordinances whereby all things come to pass and change from one form to another are everywhere and always the same. There should, therefore, be one and the same method of understanding the nature of all things whatsoever, viz., through nature's universal laws and rules.» Accordingly he proceeds: «I shall consider human actions and desires in exactly the same manner as though I were concerned with lines, planes and solids.» From this standpoint he gives a scientific account of the origin and nature of the emotions, showing how they necessarily arise from certain assignable causes, and how their intensity depends on definite natural conditions. The various emotions are all found to be compounds of the primary states, pleasure, pain and desire. But this reduction of the emotions to law is only a preliminary step in Spinoza's treatment. To attain freedom, it is first necessary to recognize the bondage of man, the fixed determination of the emotions through natural laws. But just as knowledge is power in regard to external nature, so we can free ourselves from the emotions by understanding their laws. The mind is, after all, something more than a series of passive states. Its essence consists in an effort to preserve its own being to promote its own good. And in carrying out this purpose it finds that nothing is so serviceable as knowledge. Through knowledge it is possible to free man from the bondage of the emotions. An emotion when understood becomes transformed and ceases to be a mere state of passivity. Moreover, when the conditions of an emotion are understood, it is possible to arrange and associate the various emotions in such a way as to strengthen and promote the occurrence of those that are desirable, and to weaken and repress those which are hurtful. The highest kind of knowledge for Spinoza is not scientific reason, but intuition, the direct insight that all things follow necessarily from the nature of God and hence form one system. To see all things, not as a series of events in time, but in their necessary logical relation to God, is what Spinoza calls viewing the world under the form of eternity (*sub specie æternitatis*). And this highest knowledge gives rise to the intellectual love toward God (*amor intellectualis*) which is the highest good or blessedness for man. It is through the strength of this emotion, which is not a passion but the highest activity of mind, that the other emotions are mose successfully governed and transformed. This intellectual love toward God enables the mind to renounce entirely all finite or personal desires, as well as all envy and jealousy. «He that loves God does not demand that God should love him in return»; he demands nothing for himself, but acquiesces completely in the order of the universe. Moreover, Spinoza argues that since this knowledge and the intellectual love to which it gives rise are eternal, the mind which experiences these must have something in it which is eternal and which cannot be destroyed with the body. Scholars, however, maintain that it is still doubtful whether Spinoza pronounces in favor of individual immortality. An interesting feature of Spinoza's philosophy is the close relation which he always recognizes between the individual and society. It is no merely individual good for which he was seeking but one which as «many others as possible» might share with him. In numerous passages he approached very near to the modern conception of the individual as standing in an organic relation to society.

For about a century after Spinoza's death his philosophy was wholly neglected, and his name used by both orthodox and unorthodox writers in a depreciatory way as that of an utter atheist who deserved little attention. Lessing was the first thinker who knew and appreciated Spinoza, and a controversy after his death between Mendelssohn and Jacobi as to Lessing's real opinions did much to spread a knowledge of the system in Germany. Goethe was deeply influenced by Spinoza and helped to awaken interest in the Spinozistic philosophy. Thus, since the beginning of the 19th century, Spinoza's ideas have affected in important ways the development of modern thought. It was Novalis who called Spinoza «The God-intoxicated man.»

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SPIRACLES, the apertures on the sides of the body in insects, centipedes, spiders, etc., through which air is admitted to the breathing organs or trachæ. See Insects.

SPIRÆA, a genus of deciduous shrubs of the order *Rosaceæ*. The species (about 50) are natives of the northern temperate zone; but, being widely popular in shrubberies, an enormous number of varieties have been produced, and the plants have been introduced into southern temperate countries, where some have escaped from cultivation. They are medium or small shrubs with usually little leaves and corymbs, panicles or umbels of white, pink or light crimson flowers, which appear either in profusion for a short time in spring or more sparsely and for a longer period during summer. The various species and varieties are adapted to a wide range of soils and situations, from swamp to rocky hillside and from the full glare of the sun to shade. Consult Baily, 'Cyclopedia of American Horticulture' (New York 1900–02).

SPIRAL, a curve, line or thing that winds about a centre, while also receding from it. The turns or whorls may be flat in one plane, or may rise spire-like, hence the name. Less accurately one that winds around a central axis, while advancing, as in a familiar form of coiled spring; properly this is helical. In geometry the term is confined to a curve in a plane that winds continuously around a centre with steadily increasing radius vector; also a single complete turn in such a continuous spiral. A so-called spiral that departs from a plane is the loxodrome. The mechanics of spirals have proved of great interest in logarithms. See Curves, Higher Plane; Spring.

SPIRE, a sharply-pointed, tapering roof, most commonly the roof of a tower, though a light structure often set at the crossing of the roof in a cruciform church is also called a spire (French, *flèche*), the term covering the lantern with upright sides from which the pointed roof swings. The term is hardly applied to a roof of which the slope is less than an angle of 60° with the horizon and even a slope of that acuteness makes a blunt spire.

Spires may be formed of wood and covered with wood or metal or even tiles, exactly like an ordinary roof of lower pitch, but the aim has always been to build the whole of stone and top it with a cross or a final of leafage or both.

The spire is associated with mediæval building in the west of Europe, and its greatest development is of the years 1180 to 1500 A.D. In later Gothic art the spire loses its character of roof in that its surfaces are occupied with open or pierced tracery, as in the German churches of Freiburg in Baden and Thann in Alsatia (Alsace), and the cathedral of Burgos in Spain. In the granite-building country of Brittany this decoration is common, though the openings are smaller and the spires look more massive. The latest development is that seen in Antwerp Cathedral and in Strassburg Cathedral. At Strassburg the roof lines have disappeared and the spire is a cage of sloping bars of stone which carry an indefinitely great number of pinnacles; and in Antwerp a series of vertically-walled lanterns are surrounded by bold pinnacles which are themselves spirelets of considerable size, the whole tapering to the cross. Other spires of the same 15th century and 16th century Gothic have pierced galleries or open stories of arched work alternating with the solid and roof-like slope of the spire. Such a one is the famous north tower of the Cathedral of Chartres.

The highest spires existing are those of Cologne Cathedral (modern from ancient design), 511 feet from pavement to top of cross; the Church of Saint Nicholas at Hamburg, 475 feet six inches; Strassburg Cathedral, 465 feet; Church of Saint Martin at Landshut in Lower Bavaria, 462 feet; the Church of Saint Stephen, Vienna, 450 feet; Antwerp Cathedral, 407 feet six inches; Salisbury Cathedral, 400 feet. Structures in metal are not considered here.

Russell Sturgis.

SPIRES, spīrz (German Speyer, spī'ĕr), Germany, in Bavaria, capital of the district of Pfalz, at the confluence of the Rhine and the Speierbach, 10 miles southwest of Mannheim. It is an important government town, ancient royal residence, religious centre of various denominations and the seat of the German Diet. The chief glory of the town is its cathedral (1030) begun by Conrad and completed by Henry IV (1061). It has been embellished by frescoes and statuary, and the ashes of eight German sovereigns repose within its walls. Other interesting buildings are the Retscher palace, the consistory, the gymnasium, a Roman Catholic seminary and other institutions, hospital, orphanage, a real-school and a museum containing German antiquities. The important industrial works include foundries, cotton mills, breweries; the manufacture of machinery, tobacco and leather goods. The Reformers here first protested (1529) against existing Catholic dogmas and institutions. Pop. 21,856.

SPIRIT, Holy. See HOLY GHOST.

SPIRIT-DUCK. See BUFFEL-HEAD.

SPIRIT FRESCO. See PAINTING, TECHNIQUE OF.

SPIRIT OF LAWS, The (L'Esprit des Lois). «Montesquieu,» says Professor Giddings, «converted social philosophy into descriptive social science.» An eminent modern sociologist thus concisely summarizes the fundamental contribution of one of the most prominent participants in that general intellectual movement which brought about the transformation of social philosophy into the modern science of sociology. The work which rightfully entitled Montesquieu to this important distinction was 'The Spirit of Laws,' which appeared in 1748.

'The Spirit of Laws' has traditionally been regarded as primarily, if not entirely, a contribution to the literature of political theory and, more specifically, as the work which gave the doctrine of the «separation of powers» its vital impulse and made it both a persistent dogma in political science and a leading principle in modern constitutions. Viewed in its broadest aspects, however, this major work of Montesquieu was more than the instrument for the promulgation of a single dogma in political theory; it was even more than an extensive treatise on general political theory; it was, in fact, a most significant and influential contribution to the literature and methodology of general social science. 'The Spirit of Laws' was differentiated from the contemporary works on political theory not only by the profundity and scope of its inquiry, but also through the method by which it approached the problem of the analysis of the chief factors in social and political organizations. It was the first great inductive and objective analysis of social and political processes since Aristotle's 'Politics,' written some 2,000 years before. There had been plenty of semi-descriptive material in the works of earlier and contemporary writers, but this had been mainly concerned with scenes and episodes from biblical and classical mythology and history, in which the presentation of the exploits of Nimrod, Seth and Enoch and the heroes of Homer and Livy had been much more conspicuous than an analysis of contemporary societies. Montesquieu reflected the influence of the geographic discoveries of the two previous centuries by virtue of the fact that he turned his attention to the many and varied types of existing societies and sought his «men of nature» among living savages rather than among the mythical personages who had exhibited their characteristics in the period before the «fall of man.» 'The Spirit of Laws,' then, was as truly the point of departure for modern descriptive sociology as was Hume's 'Treatise of Human Nature' for psychological sociology. By emphasizing the fact that wide observation must precede generalization, he gave a practical application in social science to the general methodological principles which had been advanced in natural science by Francis Bacon. This constitutes the enduring contribution of Montesquieu to the history of social science and political theory and it will remain unimpaired long after his specific doctrines have become obsolete and forgotten.

Such is the general significance of the work of Montesquieu as set forth in 'The Spirit of Laws'; his specific contributions may now be summarized. Among the more important of these was his conception of the origin and nature of law. Comte, in describing the significance of 'The Spirit of Laws,' said on this point: «The great strength of this memorable work appears to me to lie in its tendency to regard political phenomena as subject to invariable laws like all other phenomena.» Montesquieu's definition of law as «the necessary relations springing out of the nature of things» was truly epoch-making, being in all probability the first correct statement of what is now generally accepted as an accurate definition of a sociological law. From the different types of relationships there proceeded the various types of laws, as, for example, political law grows out of the relations of the governed and governing in any political community; and civil law out of the everyday relations between the individual citizens in the community. Laws, springing thus out of basic relationships, must be related to the particular circumstances of a given society and its environing conditions. Laws are, therefore, natural and beneficial just in proportion as this perfect adaptability between a law and its social environment is attained. Finally, all types of laws are closely interrelated and should be consistent in their totality. The highest achievement of human intelligence is to secure this consistency of all types of laws and to prevent the encroachment of any type upon the domain of another. The entirety of these relationships — of social groups and individuals giving rise to human laws; of laws to the social and physical environment, and of the different types of laws to each other, constitutes the spirit of laws and Montesquieu's main task was to trace in some detail the nature and results of these relationships.

Following the general premises laid down above, another highly significant proposition advanced by Montesquieu, in which he was thoroughly in accord with modern social theory, was that in which he relinquished the contemporary absolutism regarding social and political organization and maintained the then novel doctrine of the relativity of the excellence of institutions. The excellence and effectiveness of laws and of social and political institutions he held to be dependent not upon any intrinsic superiority, but upon their specific adaptability to the particular social environment in which they are found or in which they may be intended for application. Now the social environment, according to Montesquieu, is essentially determined by the historical conditions of the development of the particular society and by the surrounding physical environment. In accordance with this type of reasoning he endeavored to discover and indicate the relative excellence of the different forms of law, political organization and social institutions among the diverse peoples of the earth according to their relation to the various conditions of the physical environment and the resulting national of social and political phenomena, and he presented what was by far the most complete and accurate interpretation of social processes and political institutions in terms of environmental influences that had been developed by any traits and customs. This led him into the most comprehensive inductive and descriptive study writer. His treatment of the significance of climatic conditions upon mankind was especially exhaustive and has had a wide influence. But while Montesquieu's studies along this line gave an added impetus to the development of that school of «environmentalists» which has been most notably represented by Ritter, Buckle, Ratzel, Semple and Huntington, his theories were by no means original. As Dedieu has recently shown in a most convincing manner, Montesquieu took over his environmental theories bodily from the English physician Arbuthnot's ‹Essays on the Effects of Air on Human Bodies› and drew his descriptive material almost wholly from Chardin's ‹Travels in Persia.›

While Montesquieu has received the respectful attention of sociological writers chiefly on account of his emphasis upon the element of descriptive analysis and his environmental theories, his past reputation and his present notoriety among political theorists has been founded upon his famous doctrine of the separation of governmental powers as the chief safeguard of political liberty. This theory, again, was not original as it was taken almost directly from Locke's differentiation of the powers of government into the legislative, executive and federative branches; but Montesquieu brought his analysis more into harmony with modern political terminology, and his treatment was so vigorous and elaborate that the doctrine has become inseparably connected with his name. Accepting this tripartite division of governmental powers as a logical and fundamental necessity, Montesquieu argued that each function must be exercised by a separate and independent organ if any guarantee of political liberty was to be secured by the citizens. This famous doctrine was deeply absorbed by the framers of the Constitution of the United States, and it was given a more important place in that document than any other single dogma of political science. Famous and influential as this theory may have been, however, it is now generally recognized to be historically inaccurate and practically unworkable. Montesquieu derived his dogma from a superficial study of the externals of the English Constitution, while, in reality, by 1748 the totality of governmental powers in England had become absorbed by the single branch of the Parliament and the Cabinet, viewed as a committee of the Parliament. Not only was it thus, in its origin and derivation, the result of a misinterpretation, but, as Professors Ford, Goodnow and Powell have so clearly pointed out, it has proved unworkable in practice: and most of the advances which the United States has made in effective national administration since 1787 been effected by gradually breaking away from the practical application of the doctrine of the separation and independence of governmental powers.

One more specific contribution made through the ‹Spirit of Laws› should be mentioned and that is the calm and judicious criticism of the cruel, barbarous and irrational criminal procedure of the time and the moderate and enlightened suggestions offered as to the methods whereby it could be reformed. It was from the treatment of this subject in the ‹Persian Letters› and the ‹Spirit of Laws› that Beccaria received his inspiration for his epoch-making work on ‹Crimes and Punishments.› In attempting, by way of summary, to differentiate the elements of permanent value in Montesquieu's work from what is transitory or already antiquated or discredited, it seems safe to hold that he will be accorded a permanent and honorable place in the history of the development of social science and political theory on account of the vigor and priority of his insistence upon the doctrine of the relativity of the excellence of institutions according to their adaptability to the characteristics of a given population and upon the proposition that sociological and political generalizations must proceed from a wide observation of concrete facts and conditions and not from a priori assumptions of the deductive philosopher. These will ensure him the respectful consideration of the student of the history of social science long after his unfortunate insistence upon the doctrine of the separation of governmental powers has been forgiven if not forgotten. The standard edition of Montesquieu's works is that by E. Laboulaye (7 vols., Paris 1875–79). Nugent's translation of ‹The Spirit of Laws› has acquired something of the reputation of a classic. The best analysis of the doctrines of Montesquieu in English is to be found in chapter XII of W. A. Dunning's ‹History of Political Theories from Luther to Montesquieu.› More extended treatments are to be found in Janet's ‹Histoire de la science politique› (Vol. II, pp. 322–399); in Franck's ‹Réformateurs et publicistes de l'Europe› (Vol. III, pp. 133–283), and in Dedieu's ‹Montesquieu et la tradition politique anglaise en France.› Montesquieu's contributions to history are analyzed and appraised by Fueter, ‹Histoire de l'historiographie moderne› (pp. 475–478), and in Flint's ‹History of the Philosophy of History› (pp. 262–280).

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SPIRIT LEVEL, an instrument used by surveyors and others for determining a level or plane parallel to the horizon and also the relative heights of two or more stations. It consists of a glass tube nearly filled with alcohol, preferably colored. The remaining space in the tube is a bubble of air and this occupies a position exactly in the middle of the tube when the latter is perfectly horizontal. The tube is mounted on a wooden bar, which is laid on a beam or other object to be tested; or it is mounted on a telescope or theodolite and forms the means of bringing these instruments to a level, the slightest deviation from the horizontal position being indicated by the bubble rising toward the higher end of the tube. The spirit level quadrant is used for taking altitudes.

SPIRIT PLANT, called the Holy Ghost Flower, an orchidaceous plant (*Peristeria elata*) of Central America, known also as the *dove-plant,* from the resemblance of the united stamens and pistil of the flower to a dove hovering with expanded wings, somewhat like the conventional dove seen in artistic representations of the Holy Ghost. It has a spike of almost globose, sweet-scented flowers of a creamy white, dotted with lilac on the base of the lip.

SPIRITUAL CORPORATIONS, in the law of England, corporations, the members of which are "spiritual persons" or clergymen, incorporated for the furtherance of religion and perpetuation of the rights of the Church. The laws of the States of the American Union do not recognize any difference between ecclesiastical (or spiritual) and other corporations; the same statutes apply to both kinds of corporations.

SPIRITUAL EXERCISES (*Ejercicios Espirituales*). The Jesuits have occupied a prominent place in the intellectual and spiritual life of the world since their foundation nearly 400 years ago. Their founder, Saint Ignatius Loyola, as well as the Jesuits themselves have always attributed whatever of influence they had to the formation of their characters by the 'Spiritual Exercises.' This is a little volume which contains the result of Ignatius' own experiences in the spiritual life. The title given it by its author was 'Spiritual Exercises To Conquer Oneself and Regulate One's Life and to Avoid Coming to a Determination Through any Inordinate Affection.' He wrote it in Spanish, but made a translation into Latin, and it is this which is usually referred to as the original. The book is really a manual for four weeks of meditations on the significance of life and how it should be lived. The four weeks have been summed up briefly in the words (1) deformata reformare; (2) reformata conformare; (3) conformata confirmare; (4) confirmata transformare; that is (1) to reform what is deformed by sin; (2) to make what is thus reformed conform to the Divine model, Christ; (3) to strengthen what is thus conformed; (4) to transform by love the firmly made resolutions. The first week of the Exercises is called "the purgative way" because it dwells on cleansing from sin; the second and third are called "the illuminative way" because they are devoted to the intensive contemplation of the light cast upon life by the example of Christ's life; finally there is "the unitive way" by which intimate union with Christ is sought. So far from being a merely conventional spiritual book, the 'Spiritual Exercises' has been set beside the 'Imitation of Christ' by many competent critics. Janssen the German historian declared that "no other ascetic work may be compared to it." The French positivist, Lafitte, in a lecture delivered at the Collége de France, declared "These exercises are to my mind a real masterpiece of political and moral wisdom and merit careful study." It is not a book to read merely, but to live for the periods indicated. It is the basis of retreats for religious and seculars throughout the world, and serious non-Catholics often turn to it for direction in spiritual exercises. Consult Clare, 'The Science of the Spiritual Life According to the Spiritual Exercises' (New York 1896); Diertins, 'Historia Exercitiorum spiritualium' (Rome 1732); Roothaan, 'Exercitia Spiritualia' (Rome 1835; The author was General of the Jesuits and his notes are illuminating); Shipley, 'Spiritual Exercises' (London 1870); Bouhours, 'Life of Saint Ignatius' (trans. by John Dryden, London 1686).

James J. Walsh, M.D.

SPIRITUALISM, the movement, based on belief in the genuine character of Spiritualistic phenomena, that originated in 1848, in the experiences of the Fox family of Hydesville, N. Y., and which within a few years spread over the United States and England and later over the civilized world. Also the philosophy or religion based on communication with spirits or discarnate human intelligence, through the process of mediumship. The Spiritualists had in the United States, in 1918, about 200 churches and a membership of about 600,000. Within recent years many distinguished people have declared their conviction that human beings not only continue to live after "death," so-called, but that communication with them is more or less common. Among such may be cited William E. Gladstone, A. J. Balfour, Oliver Lodge, William Crookes, Henri Bergson, Cæsare Lombroso, Camille Flammarion, Schiaparelli, Conan Doyle, A. R. Wallace, William James, J. H. Hyslop, J. J. Thomson, Alfred Tennyson, Frederick Tennyson, John Ruskin and R. L. Stevenson. Many others might be added, but these are sufficient to show the dignity of the intelligences that accept Spiritualism as a fact. On the other hand, some hundreds of books have been published and innumerable magazine and newspaper articles printed, advertising and describing the frauds and humbugs of Spiritualism and many of these have come from men of high intelligence and culture, evidently wholly convinced that they were doing the world a service in exposing fraud. In this conflicting state of affairs it is necessary for an impartial statement to include all sides of the case, without effort to prejudice the reader.

History of the Movement.— In 1848 the home of J. D. Fox of Hydesville, Wayne County, N. Y., was the scene of "rappings" and various noises, accredited to spiritual agencies. The house was visited by a great many people, most of whom came away convinced that a supernatural agency was at work. Later the two daughters of this family, Kate and Margaret, moved to Rochester, where they became still more famous as the Fox sisters, being known by this name long after they married. These young women developed into what are now known as Spiritualist mediums, and produced or assisted in a variety of phenomena; went into trances and interviewed dead relatives for literally thousands of people and also brought messages from distinguished great men, in large numbers. Next appeared Andrew Jackson Davis, of Orange County, N. Y., who, when a very young man of moderate education, began to go into trances and received a great deal of scientific and philosophical information, which he put into books and lectures. His book 'Principles of Nature,' written while he was in his 'teens, passed through 34 editions. He was in great demand as a lecturer for many years and later started a publishing house in Boston to publish his own and other Spiritualistic books. Hudson Tuttle and Cora V. Richmond also developed as inspirational lecturers and writers, and their works are to be found in all large libraries. When only 17 Miss Richmond delivered remarkable addresses in a state of semi-trance, which it was admitted by all she was incompetent to produce by her own mentality. The movement spread into England, two of the most active being D. D. Home, a remarkable medium, and W. Stainton Moses, an Episcopal clergyman and Oxonian. These two lights startled England for several years. At Home's seances he used to pick up live coals from the fire by the handful and carry them around without being burned. Many of his pupils were trained to do the same thing, and he was even known to wash his face in the flames unharmed. And these things were testified to by numerous and intelligent witnesses. Moses started a publication in London, *Light*, about 1872, and working with his friend, Mrs. Speer, gave many marvelous exhibitions, developing cabinet tricks, automatic writing, slate-writing, table-tipping, etc. Slade, Bishop and a host of others gave similar exhibitions in the United States, while in France, Cahagnat, Reisenbuch and DuPotet made investigations and gave seances. The *Banner of Light* was published in Boston as the principal American organ of the cult and Spiritualist societies sprang up everywhere and the work developed into a religion, which at its height had nearly 2,000 churches or assemblies in America.

Then came a period of investigation and exposure. Mediumship and trance exhibitions, slate-writing, etc., proved so profitable that many sleight-of-hand performers, legerdemain artists and clever people engaged in it for profit, and it seemed impossible to distinguish the genuine from the impositions. There was so much discussion and dispute that in 1882 the Psychical Research Society was formed in London, and a few years later an American branch was organized. A large number of distinguished scientific men participated in this work, which many thought would result in demonstrating that Spiritualism was humbug and fraud from beginning to end. The American branch assisted the University of Pennsylvania in forming the Seybert Commission to investigate the phenomena of Spiritualism and Mediumship, and they promptly exposed a number of fraudulent mediums and their work, presented a ‹Report› and dissolved. This was far from satisfactory, as it simply showed that a number of imitators of Spiritualist methods had hoaxed a large number of people. It left unsolved the question whether others were not genuine and whether there were not definite natural laws underlying the phenomena. So the Psychical Research Society continued its work and has now been active for more than 35 years and published voluminous reports or proceedings. Several of its prominent members have committed themselves to a definite conviction as to the truth of many of the phenomena and the genuineness of communications with intelligences called dead, but living on the higher planes. Their most exhaustive experiments were made with Eusapia Paladino and Leonora Piper, and for particulars of their work the reader is referred to PSYCHICAL RESEARCH in this Encyclopedia.

Mediumship and Its Methods.— Spiritualism is based on mediumship, or the use of a human being as a means of communication between discarnate intelligences (or dead people) and living persons. These mediums are usually persons of a nervous temperament, and they always must be passive to develop what is called the «power,» but which might be better described as the ability to interpret by submission of the will and voluntary senses. It is a subjective psychic process, and very wearing and trying upon the nervous system of the medium, and it has been contended that the disposition of mediums to impose upon the public was largely due to the fact that the work so exhausted them that they were unable to keep up with the demands of their sitters, and so «faked» interviews with the dead, to give them satisfaction. Impressional or inspirational mediums are those who do not go into a full trance, but are quite conscious of their surroundings, and who, when under this slight control, make addresses or write that which is impressed on their minds from the «other side» of life. This has been done so frequently, and such wise and learned utterances have at times come so fluently from mediums of moderate education, that the fact of their being more or less inspired by intelligences of greater ability than they themselves possess, has been widely admitted. The automatic writing form of mediumship is akin to this. The medium takes a pen or pencil and waits until some influence seizes his or her hand, and writing proceeds. The composition may be good, bad or indifferent. But since such a reliable man of world-wide fame as William T. Stead, in his ‹Letters from Julia,› admits his hand was controlled and that the letters came from another intelligence; and so gifted an authoress as Elsa Barker has given us ‹Letters of a Living Dead Man,› and the son of that dead man has recognized his father from the information, and some hundreds of other really valuable books have been produced in this way, the public is becoming less skeptical. The planchette and ouija board furnish another means of mediumship, the method being described under those terms. Trance mediumship is of several varieties; its leading characteristic is that the medium goes into an artificial sleep, similar to that into which the subject of a hypnotist is thrown. In fact all the conditions of hypnotism and trance mediumship appear to be identical except that the control in one case is a discarnate spirit and in the other a living hypnotist. This phase of the subject is very fully covered in F. Huntley's ‹The Great Psychological Crime.› (See also HYPNOTISM in this Encyclopedia). The medium in a trance usually informs the sitters around that a certain individual is present, and the sitters are privileged to ask questions which the medium will answer for the spirit. The evidence that such testimony is not faked is that in a vast number of instances facts have been told of which the medium could have known nothing, and mediums have been known to speak in languages of which they were ignorant; and in many other ways the testimony has been held to transcend the ability of the medium to manufacture. Materializing mediums are rare, and this phase of mediumship has been most questioned; still there are so many instances well attested that it is hard to discredit them. A state of darkness or near-darkness is insisted on, and portions of human bodies, or an entire individual will be materialized and presented to the view of the audience, sometimes walking among them, and touching some of them, as well as engaging in more or less conversation.

It has been explained that this is accomplished by the medium's control, who draws upon the medium and the sitters for magnetism, and a certain amount of material matter, and builds this about a spirit form so that such spirit form is rendered visible. For the reality or non-reality of this phenomena the reader is referred to the bibliography at the close of this article. The subject is so disputed, and so difficult of proof, that it cannot be discussed at length here with profit. In addition to the foregoing, there are mediums who have practised a variety of cabinet tricks, as of speaking through trumpets, playing musical instruments, etc., while securely tied within a dark cabinet on the stage, the instrument being in full view of the audience and seemingly sounded without human agency. There is also a form of mediumship called «table tipping» which was very popular in England in the early days of the Spiritualist movement. Articles of furniture would be made to move about with no visible person or attachment. This seems to have been a form of levitation and this is fully discussed under that word.

Theories, Opinions and Beliefs.— Spiritualism is regarded from four different viewpoints by as many classes of observers. First, are those who are easily convinced of the reality of the communications with the so-called dead, who consider practically all mediums honest, to whom the philosophy has become a religion, and who derive a great deal of comfort from attending seances and meetings and getting messages mostly to the effect that their loved ones are well and happy. These are open and avowed Spiritualists, who resent any imputation as to the accuracy of the phenomena. Second, come those who believe the phenomena are produced wholly by trickery, legerdemain and magic, and constitute a great psychic fraud on the public. As a sub-class to these are a few who believe that «if there is anything in it, it must be the work of the devil or his subordinates.» Third, are those who admit the genuineness of the phenomena (when not faked), but who contend that such communications only put sitters in touch with the lowest and least desirable class of spirits, with the ignorant, immoral and undeveloped spirits, this being why so many American Indian spirits appear. Emblematic of this class is Ruskin, who is quoted as saying that «Having learned through Spiritualism that there is another life, I have no farther use for it.» Fourth, comes those who hold that the phenomena so widely exhibited is sometimes produced by trickery and sometimes by telepathic suggestion, by clairvoyance, telepathy and natural powers not wholly understood. Some of this class, like Sir Oliver Lodge (q.v.), have come out openly and admit their conviction of the absolute proof of intelligent communication with disembodied spirits; and others, like the late William James (q.v.), are inclined to think that the phenomena, which they admit, may be largely the reflex action of their own minds or the minds of others on the earth plane. It is this fourth class who largely constitute the members and followers of the Society for Psychical Research. That deep thinker and explainer of Darwin's theories of Evolution, Alfred Russel Wallace, said in Chambers' Encyclopædia, «Spiritualism has grown and spread continually till, in spite of ridicule, misrepresentation and persecution, it has gained converts in every civilized portion of the globe.» Sir Oliver Lodge has written: «I tell you with all the strength and conviction I can utter that we do persist, that people over there still take an interest in what is going on here; that they still help us and know far more about things than we do and are able from time to time to communicate with us.»

Conclusions.— The conclusions of the higher intelligences who have expressed themselves as being convinced of the reality of Spiritualism may be summed up as follows: Through mediumship is proved the continuity of life beyond the grave; it is no longer a religious dogma but a living fact. Spiritual intelligences are as anxious to communicate with us as we with them, but the lower and grosser intelligence seem to be the nearest to us, and most likely to be heard from in communication, and they like to impersonate great individuals and personal deceased friends of those present. This is held to account for much of the «information» that comes through, and is valueless. For many years the *Banner of Light*, published in Boston, was the leading organ of this cult. In common with other Spiritualist papers it has disappeared. They have apparently given way to Psychological publications and New Thought periodicals. While the great public includes a vast number who are viritually Spiritualists, they are less and less known by that name, but are affiliated with New Thought, Mental Science, Theosophy, Oriental cults, Psychical Research and other modern movements.

Spiritualistic teaching is largely in accord with the writings in the Bible. The «familiar spirits» were very much like some modern ones that come to mediums; the witch of Endor, the ghost seen by Balaam, the experiences of many of the prophets and saints are paralleled in Spiritualism. Seers of all ages have testified to various things about the future life that are in accord with what comes to us through the séance room. Emmanuel Swedenborg (q.v.), one of the most modern seers, has told in many volumes of his experiences in the heaven world, which he was able to see and visit without a medium. And this seems to be the distinction between a seer and a medium: the former sees clairvoyantly with his own eyes; the latter goes to sleep and takes the word of some intelligence on the spiritual plane, which may or may not represent truth.

National Spiritualists' Association.— This was organized 28 Sept. 1893 and incorporated in the following November at Washington, D. C. It comprises about 1,000 active working societies and 22 State associations; there are also 32 camp meeting associations and perhaps 900 irregular unorganized local societies and meetings of Spiritualists. They maintain an academy equivalent to a seminary and include 200 churches with a membership of 600,000. There are believed to be about 1,500,000 others attendant on their gatherings or sympathetic with their work. Their secretary states that there are about 1,500 public mediums in the country, and a much larger number of private mediums. They have 500 ordained ministers and $7,500,000 worth of church property. Their headquarters are at 600 Pennsylvania avenue, Washington, D. C.

Bibliography.— Consult the writings of Swedenborg, of Andrew Jackson Davis, Owen, Robert Dale, ‘The Debatable Land’ (1865), and Hudson Tuttle; Crookes, Wm. ‘Psychic Force and Modern Spiritualism’ (New York 1871); id., ‘Researches into the Phenomena of Spiritualism’ (1874); Wallace, A. R., ‘Miracles and Modern Spiritualism’ (1881); Peebles, J. M., ‘Seers of the Ages,’ and ‘Who Are These Spiritualists?’; Home, D. D., ‘Lights and Shadows of Spiritualism’ (1890); Moses, ‘Spirit Identity’ (1879); Babbitt, E. D., ‘Religion as Revealed by the Material and Spiritual Universe’ (1895); Hull, ‘Encyclopedia of Biblical Spiritualism’; Flammarion, M., ‘L'Inconnu’; Huntley, F., ‘The Great Psychological Crime’ (1902); Hyslop, J. H., ‘Science of the Future Life’ and ‘Psychical Research and Survival’; Carrington, H., ‘Physical Phenomena of Spiritualism’ (Boston 1907); Lombroso, C., ‘Hypnotism et Spiritisme’ (Paris 1910); Sinnett, A. P., ‘In the Next World’ (1914); Barrett, Sir Wm., ‘On the Threshold of the Unseen’ (London 1917); Lodge, Oliver, ‘Raymond, or Life or Death’ (1917); Randall, E. C., ‘The Dead Have Never Died’ (1917); Doyle, A. Conan, ‘Is Sir Oliver Lodge Right? My Conversion to Spiritualism’ (London 1918) and the Proceedings of the Psychical Research Society. See HYPNOTISM; MAGIC; PSYCHICAL RESEARCH; PSYCHOLOGY.

SPIROMETER, a contrivance for determining the capacity of the human lungs. The instrument most commonly employed consists of an inverted chamber submerged in a water-bath like a miniature gas-holder. The breath is conducted by a flexible pipe and internal tube, so as to collect in the chamber, which rises in the water and is fitted with an index marking the number of cubic inches of air expired after a forced inspiration.

SPIRULA, a genus of diminutive cuttle-fishes representing the family *Spirulidæ*, which is distinguished by the possession of an internal chambered shell of nacreous structure and discoidal form, the whorls of the shell being separate, and the siphon piercing the septa on their ventral surfaces. *S. peronii* is a species which inhabits the open ocean, and its shells are occasionally cast ashore. See CEPHALOPODA.

SPITHEAD, England, a roadsted which separates the northern coast of the Isle of Wight from the mainland near the entrance to Portsmouth Harbor (q.v.). It is much frequented by the English fleet and protected by strong forts, and extends for about two miles along the southwest side of Spit Sand. It is so safe that it received the title of the «King's bedchamber.» In 1797 it was a scene of a determined mutiny, the sailors striking for better pay, which they obtained.

SPITTA, Julius August Philipp, German musical historian: b. Wechold, Hanover, 27 Dec. 1841; d. Berlin, 13 April 1894. He was educated at the University of Göttingen. He engaged in teaching, meantime making a study of the history of music and musicians. The appearance of the first volume of his life of Bach (2 vols., 1873–82) brought him immediate recognition, and in 1875 he was appointed professor of musical history at the University of Berlin, and perpetual secretary to the Academy of Arts there. He was also connected with the High School of Music from 1875, and from 1882 was a permanent director. He wrote the biographies of Bach and Schumann for the ‘Musikalische Vorträge,’ as well as the article on Spontini for that work. He was co-editor of *Vierteljahrsschrift für Musikwissenschaft;* edited the organ works of Buxtehude (2 vols., 1875–76); and the complete edition of the works of Heinrich Shültz.

SPITTA, Karl Johann Phillip, German hymnist: b. Hanover, 1801; d. Burgdorf, 1859. After completing studies at Göttingen University, he taught from 1824 to 1828 at Lüne, where he composed the hymns which brought him into prominence. He served as pastor in several localities and became superintending clergyman at Burgdorf in 1859, a short time before his death. His hymns of perfect lyric form and purity of style are marked by spiritual elevation and a wealth of thought and sentiment embodied in fresh, vigorous language. They came into general use and retain a high position in the hymnology of the period. They appear in ‘Nachgelassene geistliche Lieder’ (1861 et seq.); in ‘Psalter und Harfe’ (1833; rev. ed. with bibliography, 1890; Jubilee ed. 1901). Consult Münkel, ‘Phillip Spitta’ (Leipzig 1861); Majer, ‘id.’ (2d ed., (Bremen 1891).

SPITS. See SHORE LINE.

SPITTELER, Carl, poet: b. Liestal near Basel, Switzerland, 24 April 1845. His father was an official of the government, being Federal Secretary of the Treasury from 1849–56. Young Spitteler attended the gymnasium at Basel, being fortunate in having among his teachers such men as Wilhelm Wackernagel, the great philologist, and Jakob Burckhardt, the author of the famous work on the Italian Renaissance. Later he studied at the universities of Basel, Zürich and Heidelberg. He began with jurisprudence and afterward changed to theology, but when a position as pastor was offered him, he felt that he must decline it. He had begun to realize his mission as an epic poet and therefore refused to work in the field for which he had prepared himself. His first work, ‘Prometheus und Epimetheus’ appeared in 1880–81. It is an allegory which symbolizes the joys and sorrows of an exalted soul striving to attain an ideal, although the loyalty to this ideal is paid for by a life full of misery. The style reminds one of Nietsche's ‘Zarathustra,’ but Spitteler was not influenced by Nietsche, as that is chronologically impossible. Rather the reverse is true, although Nietsche never acknowledged his indebtedness to Spitteler. The two works in a way complement each other. In Nietsche we have direct didactic statement, while in Spitteler a higher phase, the symbolical, is predominant. From 1870 to 1879 he spent in Russia as a private tutor and later he served as teacher in Neuenstadt not far from Berne. In 1882 he published his ‘Extramundana,’ a collection of poems. He gave up teaching in 1885 and devoted himself to a journalistic career in Basel. Now his works began to come in rapid succession. In 1891 there appeared ‘Friedli, der Kalderi,’ a collection of short stories, in which Spitteler, as he himself says, depicted Russian realism. In 1898 ‘Conrad der Leutnant’ was published; ‘Literarische Gleichnisse’ had appeared in 1892, and ‘Balladen’ in 1896.

His most important production, 'Der Olympische Frühling,' appeared 1900–03 and was revised in 1910. It is an epic poem of the heroic type in which Spitteler has given us his interpretation of life. The ancient mythology is not used as a setting but as an appeal to the imagination. He tells of the doings of gods and men in an elevated style and by implication he impresses upon us his ideas and ideals.

Gottfried Keller, the realist, had some difficulty in understanding the allegorical works of Spitteler and his admirers have been few up to recent times. Now a better appreciation of his works seems to be coming. Consult Boesche, 'Life and Works of Carl Spitteler' (in 'The German Classics,' Vol. XIV, New York, 1914); Biese, 'Deutsche Literaturgeschichte,' Vol III.

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SPITZ, or POMERANIAN DOG, a small sheep-dog, originally of the Baltic provinces of Germany, which is about the size of the spaniel, with a sharp-pointed face and an abundant white coat sometimes of great beauty. Other colors are known, including black. It was once comparatively common in the United States. See Dog.

SPITZBERGEN, spĭts-bĕr'gĕn, a group of islands in the Arctic Ocean, between Barents Sea on the east and Greenland Sea on the west, about 650 miles north of the North Cape in Norway. They lie between the parallels 76° 30′ and 80° 30′ N., and are about 450 miles east of Northeast Foreland in Greenland and 200 miles west of Franz Josef Land. The archipelago comprises three large islands and a large number of smaller ones. The largest island is West Spitzbergen, which has an irregular triangular form with the apex pointing south. Its coast is indented by many fiords, of which the two largest are Ice Fiord on the west coast, running north and northeast, and Wijde Bay, penetrating southward from the north coast. The northern branch of Ice Fiord almost meets the head of Wijde Bay. The narrow Foreland Sound separates the smaller island of Prince Charles Foreland from part of the west coast of West Spitzbergen. To the northeast, separated from the main island of West Spitzbergen by Hinlopen Strait, lies the second largest island, North-East Land. Edge and Barents islands lie on the southeast side of the groups. Of the smaller islands, Danes Island, off the northwest coast of West Spitzbergen, is notable as the place from which Andrée set out on his fatal balloon voyage to the North Pole. At the extreme north is a cluster of small islands known as the Seven Islands. The total area of the archipelago is about 27,000 square miles, of which West Spitzbergen represents about 15,000. West Spitzbergen is in the main covered with great accumulations of ice, except along the west shore of Wijde Bay, where there is a relatively fertile area. The middle of the island, west of the main watershed, is described as a region of boggy valleys, fertile slopes and mountain ridges, or the remains of a high plateau. The highest measured peak of the island is Horn Sound Tind in the south, fully 4,500 feet above sea-level. Large glaciers are found throughout the whole group, but especially on the eastern coasts. The average limit of solid drift ice skirts the northern edge of the archipelago. The ocean bed around the islands is shallow. Geologically the backbone of the island consists of granite, with gneiss and other archaic rocks, but Carboniferous, Triassic, Jurassic, Miocene and even more recent formations are also well represented. During Miocene times Spitzbergen had a luxuriant flora, and there was also a postglacial period of genial climate favorable to the development of a varied phanerogamic flora. The proximity of the Gulf Stream renders the climate, especially on the west coasts, less severe than that of other places in the same latitude. For four months in winter the sun is below the horizon, and for an equal period in summer always above it. The most characteristic plants of the archipelago are mosses and lichens. Rather more than 100 species of phanerogams, however, have been collected on the islands. The grasses form nearly a quarter of these, and next to them in number of species are the cruciferous plants. The larger forms of animal life are foxes, bears and reindeer, in pursuit of which, as well as the walruses and seals abounding along the coasts, the islands are frequently visited by the Norwegians and Russians. Sea-fowl are at times so numerous that they literally hide the rocks and darken the air. The minerals include beautiful marble and good coal. The group is said to have been discovered (1553) by Willoughby, but the islands were known to the Russians before that time. They were again discovered in 1596 by the Dutch navigator Barents. To the latter navigator the islands owe their name (in Dutch spelling Spitsberghen), signifying "peaked mountains." The coasts of the chief islands have been explored by many expeditions since that time, and during the 19th century the islands were used as a base for expeditions toward the North Pole. The interior was hardly known till the explorations in 1896–97 of Sir W. Martin Conway, who was the first to cross West Spitzbergen from west to east. There are no settled inhabitants, but explorers and others have often passed one or more winters in the archipelago. In the days of the Spitzbergen whale fishery there was a thriving Dutch village called Smeerenberg on a small island to the northwest of West Spitzbergen. Tourist steamers sometimes sail to Spitzbergen during the summer months. A tourist hotel was built in 1896 at the entrance to Advent Bay, a branch of Ice Fiord.

SPITZKA, Edward Charles, American neurologist: b. New York, 10 Nov. 1852; d. 1914. He was graduated from the College of the City of New York and subsequently (1873) from the medical department of the University of New York, and studied later at the medical schools of Leipzig and Vienna, becoming in the latter institution a laboratory assistant in embryology and histology. On his return to New York he made the nervous system his specialty, and gained national reputation as expert in insanity in the trial of the assassin Guiteau. He is the discoverer of the interoptic lobes of the lower brain. He was vice-president of the neurology section at the International Medical Congress of 1887, and honorary president of the Pan-American Medical Congress in 1893. He was editor of the *American*

Journal of Neurology (1881–84), and has published a 'Treatise on Insanity,' etc.

SPIVAK, Charles D., American physician: b. Krementshug, Russia, 25 Dec. 1861. Leaving Russia in 1882, on account of his political views he came to this country and worked as day laborer in New York, as a mill hand in Maine, and as a farmer in New Jersey, until he was enabled to graduate from the Jefferson Medical College, Philadelphia, in 1890, spending some time at the Berlin University (1891–92). In 1894–95 he was chief of clinic, gastro-intestinal diseases, at the Philadelphia Polyclinic. Settling in Denver, Colo., he became lecturer on diseases of the gastro-intestinal tract, Denver School of Medicine (1896–1900), and professor of anatomy at same college (1897–98).

SPLEEN, a vascular abdominal organ which, in man at least, is now generally regarded by physiologists as forming one of the ductless glands, and which is accordingly classed with the thyroid gland, thymus, and suprarenal capsules. All vertebrates — with the exception of the lancelet, and probably the lampreys, lepidosirens (or mudfishes), and the ceratodus or barramunda — possess a spleen, which is absent from the sub-kingdom in certain aberrant fishes only. In man, the spleen lies in the upper part of the abdomen, and is situated in the left hypochondriac region, contiguous to the cardiac or gullet end of the stomach. Its outer surface is smooth, and lies in contact with the under surface of the diaphragm or midriff, this latter muscle separating the spleen from the 9th, 10th and 11th ribs of the left side. Externally the spleen is covered by the peritoneum, and is connected with the stomach by the omentum, known as the gastrosplenic band. Its internal aspect is concave, and is divided by a longitudinal groove or fissure named the hilum. The blood-vessels and nerves of the spleen enter and leave the organ by the hilum. Inferiorly the internal surface of the spleen is in contact with the pancreas (q.v.) or sweetbread, and posteriorly with the suprarenal capsule of the left kidney. The upper end is of rounded conformation, and is thick; while the lower extremity is pointed, and is in contact with the colon (q.v.). A suspensory ligament or special fold of peritoneum attaches the spleen to the under surface of the midriff. The size of the spleen appears to vary much. Its average size in the healthy adult is about five inches in length, by three or four inches broad, and one to one and one-half inches in thickness. Its average weight is seven ounces.

The spleen is invested by an outer serous membrane formed by the peritoneal layers. It covers the entire surface. Below the serous coat is a second investment of fibrous nature. This is of elastic structure, and forms the framework or supporting fibres of the internal structure. The essential spleen matter is called spleen pulp. It is of a dark brownish-red color, and when microscopically viewed is seen to be composed of colored parts, consisting of red blood corpuscles and other cells of colored nature; while other bodies of deep-red, yellow, or black hue, existing singly or aggregated together, may be seen amid the spleen pulp. The colorless elements seen in the spleen-structure are granular matters, free nuclei of cells, as well as nucleated cells or vesicles. The colorless elements form about two-thirds of the pulp and are of the same nature as the round white cells of lymphatic glands (q.v.). They are also similar to white blood-corpuscles. When the spleen is cut through, as in a vertical section, a number of opaque bodies of small size, masses of round cells, are seen to be scattered throughout its substance. They are the Malpighian or splenic corpuscles, which have intimate relations with the veins of the spleen, and resemble lymph-corpuscles (see LYMPH) in form. The splenic artery, supplying the organ with blood, is of large calibre, and pursues a remarkably tortuous course within the spleen. The veins of the spleen, like the splenic artery, are of large relative size, and they unite to form a large (splenic) vein, which pours its fluid into the portal vein. The nerves of the organ are derived from the right and left semilunar ganglia, and form the right pneumogastric nerve.

The purpose and functions of the spleen have been the subject of much speculation; but in modern research has shown that in all probability the spleen is the seat of the change and elaboration of the red blood-corpuscles, which form such characteristic elements in vertebrate blood. It is thus to be regarded as a blood-gland, or kind of lymphatic gland. The spleen may be removed or extirpated, both from man and lower animals, without any apparent bad consequences. This is explicable on the ground that other glands (thyroid, thymus, or even the ordinary lymphatics) may assume the functions of the absent spleen.

Of the diseases to which the spleen is liable inflammation and enlargement are the most common. Inflammation (splenitis) may result in splenic abscess and gangrene; while the organ may be affected by various forms of tubercular and syphilitic disease, and is liable to be ruptured by violence — as from a direct kick or blow. Enlargement (known as ague-cake) results from chronic ague or intermittent fever, and may sometimes be met with in pregnant women, and in leucæmia (q.v.). See INTESTINE.

SPLEENWORT. See ASPLENIUM.

SPLICE. See KNOTTING AND SPLICING.

SPLINT, *in surgery*, a thin piece of wood or other material, used to hold or confine a broken bone when set, or to maintain any part of the body in a fixed position. The original wooden splint is falling into disuse, modern surgeons preferring to build up something more easily molded to a desired shape. A plaster-of paris splint is made by charging a bandage of muslin or other open material with plaster of paris, and washing over each layer with water. The plaster hardens rapidly. Metal, wire, gutta percha and papier maché have also been employed. Often it is found advantageous to build up a plaster splint and stiffen it on a backbone of wood or metal.

SPLINT, *in veterinary surgery*, a bony enlargement on a horse's leg, between the knee and fetlock. It usually appears on the inside of one or both forelegs, frequently situated between the large and small cannon bones, is due to concussion, and most common in young horses that have been driven rapidly along hard roads before their bones are consolidated. When of recent and rapid growth the splint is hot and tender and causes lameness. A piece of spongio-piline saturated with cold water should be applied to the splint, kept in position with a light linen bandage, and wetted with cold water or refrigerant mixture every hour. Perfect rest must be enjoined for 10 days or a fortnight. When the limb is cool and free from tenderness, the swelling, which will still remain, may be greatly reduced by some stimulating applications, such as the ointment of the red iodide of mercury, the common fly blister, or the firing iron.

SPLITAIL, a Californian chub (*Pogonichtys macrolepidotus*), dun-colored with silvery sides and the tail divided into two lobes, of which the upper is much the longer; length, 12 inches. It is common in all the lowland streams of central California.

SPLÜGEN, Switzerland, in the Alps bordering the Italian frontier, is a lofty mountain 9,350 feet high, with a pass connecting the Rhine Valley of the Grisons, with the valleys of Lombardy. The pass, though known to the Romans, was of a dangerous character, because of frequent heavy avalanches. A French army in 1800, traversing the old path, lost a great number of men and horses overwhelmed by avalanches. The modern pass, completed in 1823 by the Austrian government, contains several galleries of massive masonry as a protection against the descent of avalanches. It rises 6,940 feet above sea-level, and is a bold piece of Alpine engineering, rendering the route advantangeous for automobile tourists fond of mountain travel. There is a small inn at a high point for the refuge of travelers, and a hotel at Monte Spluga. The scenery comprising deep cascades, sharp rocks, wild ravines and snowy peaks, presents a variety of magnificent views.

SPODUMENE, spŏd'ū-mēn, a mineral occurring generally in monoclinic crystals often of great size. It has a well-developed cleavage, most perfect parallel to the orthodiagonal axis, and to the prism planes. It is not unlike feldspar in appearance, but may be distinguished from that mineral by its higher specific gravity (3.13 to 3.19), and its more pearly lustre. Its hardness is 6.5 to 7 of the scale, and its color grayish-green, passing into greenish-white and grayish-white, rarely faint-reddish. Its composition is: Silica 64.2; alumina 29.4; lithia 6.4. In eastern United States it is found at Windham, Me.; Winchester, N. H.; Goshen, Chesterfield and Norwich, Mass., and Brookfield, Conn. Very large crystals of the mineral are found in pegmatite dikes in the Black Hills, South Dakota. It also occurs in Sweden, in the Tyrol, and in Scotland. The mineral is valuable as a source of lithium, and a very transparent lilac-colored variety is used as a gem, under the name KUNZITE.

SPOFFORD, spŏf'ŏrd, **Ainsworth Rand**, American librarian: b. Gilmanton, N. H., 12 Sept. 1825; d. 11 Aug. 1908. He received a classical education from private tutors, engaged as a bookseller and publisher in Cincinnati, and in 1859-61 was associate editor of the Cincinnati *Daily Commercial*. He was first assistant librarian of Congress in 1861-64, librarian-in-chief in 1864-97, and chief assistant librarian till his death. He edited Catalogues of the Congressional Library; ‘Annual American Almanac’ (1878-89); was associate editor of ‘Library of Choice Literature’ (10 vols.); ‘Library of Historic Characters and Famous Events’ (10 vols.); ‘Library of Wit and Humor’ (5 vols.); and has written ‘Massachusetts in the American Revolution’ (1895); ‘A Book for All Readers’ (1900), etc.

SPOFFORD, Harriet Elizabeth Prescott, American poet and writer of fiction: b. Calais, Me., 3 April 1835. She was graduated from the Pinkerton Academy in Derry, N. H., in 1852 and was married to R. S. Spofford in 1865. She was one of the earliest contributors to *The Atlantic Monthly*, her story ‘The Amber Gods,’ attracting the attention of discriminating readers as much for the tropical luxuriance of its style as for the theme. Her earlier work in both verse and prose is in every case marked by originality and distinction of style, but her later work, while not without charm, is more conventional and informing. Among her publications are ‘Sir Rohan's Ghost’ (1859); ‘The Amber Gods, and Other Stories’ (1863); ‘Azarian’ (1864); ‘New England Legends’ (1871); ‘Hester Stanley and Saint Marks’ (1883); ‘A Scarlet Poppy’ (1895); ‘In Titian's Garden,’ verse (1896); ‘Old Washington’ (1906); ‘The Making of a Fortune’ (1911).

SPOHR, spōr, **Ludwig**, German composer: b. Brunswick, 5 April 1784; d. Cassel, 22 Oct. 1859. He studied music, and at an early age acquired a great reputation as a performer on the violin. About 1805 he was appointed conductor of the court concerts at Gotha, and became afterward musical director of the Theatre an der Wien, Vienna, for which he wrote some of his finest dramatic works. He became chapel-master at Frankfort, 1817-19, and at the electoral court of Hesse-Cassel in 1822, and continued in that office till near the end of his days. Spohr was the composer of violin music, consisting of solos, concertos and chamber-pieces, and his performance on that instrument was characterized by breadth and vigor of tone. He is also the author of ‘Faust’ (1818); ‘Jessonda’ (1823); ‘Zemire und Azor’ (1819), and other operas, which occupy a high rank among musical compositions. His oratorios, ‘The Last Judgment’ (1826); (‘Die letzten Dinge’), ‘The Fall of Babylon’ (produced first at a Norwich musical festival), and ‘Calvary’ (1835), (‘Des Heilands letzte Stunden’). His last opera was ‘Die Kreuzfahrer,’ produced in 1845. His finest symphony was ‘Die Weihe der Tone’ (1832).

SPOILS SYSTEM. See CIVIL SERVICE REFORM.

SPOKAN. See SALISHAN INDIANS.

SPOKANE, Wash., city, county-seat of Spokane County, and the commercial and financial centre of the territory known as the Inland Empire, comprising eastern Washington, northern Idaho and western Montana. Spokane to the Indian tribe of that name meant “Children of the Sun.” The place was originally called Spokane Falls, so named from the series of cascades in which the Spokane River falls through the heart of the city. Five transcontinental railroads operate into Spokane over their own tracks — the Northern Pacific, the Great Northern, the Chicago, Milwaukee and Saint Paul, the Canadian Pacific and the Oregon-Washington or Union Pacific. Two others, the Burlington and the Northwestern, operate under traffic agreements. All have branch lines radiating into the corners of the Empire. The heart of the city is bisected by the Spokane River, having a series of abrupt falls making possible the development of 400,000 horse power of electrical energy. Only 172,000 horse-power has been developed up to the present for the operation of Spokane street cars and the illumination of the city and to provide power for the factories of Spokane and the surrounding country. This power also is transmitted 100 miles east to the Cœur d' Alene mining district. The city of Spokane, which in 1900 had only 36,000 inhabitants, had in 1910 a population of 104,402, according to federal census.

Industries.— Spokane's factory output is valued at $50,000,000 per year, and 12,000 are employed in manufacturing. Some of the different industrial establishments are lumber mills, manufacturing different kinds of lumber products, sewer and water pipe works, flour mills, flour mill machinery works, brick and terra cotta works, foundries, vinegar and pickle works, machine shops, iron works, cereal food plant, pottery, mattress and furniture factories. Other manufactures are jewelry, tobacco products, gloves, clothing, brooms, trunks, wooden and tin ware, dairy products, packed and canned meats. A large part of the industrial prosperity is owing to the mines in the vicinity, the great agricultural and horticultural resources of the surrounding territory, extensive stock-raising, and to the vast water power which offers special inducements to manufacturers. This power is made available bv the generation of electricity. Spokane is also the centre of a rich lumbering region. The city is surrounded on the north, east and south by the greatest area of white pine timber forests in the United States. The city has grain elevators, an electric light plant, an artificial gas plant and large lumber yards.

Commerce and Transportation.— Spokane is the commercial as well as the industrial centre of eastern Washington, northern Idaho and western Montana. Spokane ships to the markets of the world the fine wheat from the interior basin of the Columbia River, the vegetables, deciduous fruits, berries and the products in general from a region of fertile soil, and the semi-arid districts of the Spokane, Yakima and Wenatchee valleys, made productive by irrigation. Crop failures in this region, popularly known as the «Inland Empire,» are unknown. The wealth production from the farms, orchards, mines, forests and ranges of the Spokane country in a recent year amounted to $217,158,000, as follows: Grain yield, $93,000,000; mineral output, $41,158,000; livestock and poultry, $27,500,000; lumber, $14,500,000; farm and garden products, $17,000,000; apples and other fruits, $11.000,000; dairy products, $13,000,000; total, $217,158,000.

Public Interests.— Spokane is finely situated in the Spokane River Valley. In summer the winds from the Cascades and Rockies temper the heat, while the breezes from the Japan current of the Pacific Ocean make extreme cold unknown here. In the 35 years that the United States Weather Bureau has been here, there has not been an instance of loss of life from extreme heat or cold or other climatic conditions, such as heavy winds. Spokane leads all cities in the United States in public park area proportionate to population, having 1,933 acres valued at $2,000,000. The city also leads all others in percentage of home owners, 51 per cent of the people owning their homes, according to the United States census. The city has 68 miles of paved streets; 392 miles of graded streets; 633 miles of concrete sidewalks; 144 miles of sewers; 137 miles of gas mains; 137 miles of electric street railways; 1,408 street lights; 356 miles of water mains; 2,260 fire hydrants. The water supply comes from an underground river reached by deep wells, and is among the purest in the world. The death rate in 1915 was 8.14 per 1,000 of population, one of the three lowest among the cities of the United States. Some of the principal buildings are the government building, Davenport hotel, Old National Bank, Paulsen building, public library, city hall, county courthouse, Gonzaga College, high school, Auditorium, Review, Empire State buildings, Masonic temple, Spokane Club building, Spokane Amateur Athletic Club building, Protestant Episcopal and Roman Catholic cathedrals, and the churches and the schools. Fort Wright, a United States military post, is located on a tract of land, 1,022 acres, which the city gave to the government in 1894-95, on condition that a large military post should be established and maintained here. The city is especially noted for its fine residences and paved streets, and is known throughout the Pacific Northwest as the «Home of the Mining Kings.»

Education.— Spokane is the educational centre of the «Inland Empire.» The schools of higher education are Gonzaga University, Whitworth College, Spokane College and Spokane University. The Catholic Church conducts Saint Michael's scholasticate for the training of priests. There are two high schools and five parochial schools, as well as four business colleges. Four hundred and ten teachers are employed in 35 grade schools. The value of the public school buildings is $2,505,396.92. Value of building sites, $740,741.90; school equipment, $351,762.78. Total school enrolment in 1918 was 20,134. The city maintains a public library and seven branches in residence districts, besides 200 classroom libraries in public and private schools. Value of books and equipment, $118,000. There are 112 churches of all denominations in Spokane.

Banks and Finance.— There are 13 banks, of which three are national. The combined capital is $4,325,000; surplus and undivided profits, $1,354,919; deposits (May 1919), $46,592,052. Bank transactions in 1918 aggregated $1,263,198,089; clearings, $422,346,431. The combined tax rate in 1918 for State, county, city and school purposes was 47 mills, on an assessed valuation of $108,760,004. Bonded debt, $4,710,000.

Government.— The city operates under a commission charter and five commissioners, elected on a non-partisan basis. The responsibility is centralized and the work divided under the following headings: finance, public safety, public affairs, public works and public utilities.

Historical.— Spokane's brief history is interesting. The first settlement was made in the summer of 1872, when a handful of sturdy people gathered at the Spokane River Falls. Earlier it was the home of trappers and hunters, who sold their pelts to the Hudson's Bay Company and the Astors, who in turn maintained the Spokane House, before the Oregon country became part of the United States. But the town did not really get under way until the Northern Pacific arrived in 1881. Eight years later fire devastated the 30 blocks in the business district. It was the first real test and it found the people of Spokane undaunted. Since then its growth has been steady and substantial. The population figures given by the Federal Census Bureau follow: (1890), 19,222; (1900), 36,843; (1910), 104,402; (1914), 135,657. Population in 1919 is estimated at 137,000.

R. A. Laird,
Publicity Secretary, Spokane Chamber of Commerce.

SPONDIAS, a genus of tropical trees belonging to the family *Anacardiaceæ*, several of which are cultivated for their plum-like yellow fruit (drupes). The leaves are alternate and odd-pinnate, with numerous leaflets. The flowers are small, polygamous, in spreading terminal panicles, with four or five expanded petals. The leaves and bark have therapeutic value. The fruits of various species are known as hog-plums; they are laxative, and often austere in flavor. *Spondias dulcis*, the pomme de cytheie, sweet Otaheite apple, or wi-fruit, is the golden-yellow fruit of a tree about 50 feet high, common in Polynesia. This fruit has an apple-odor, but a sharp flavor resembling that of a pineapple, and stringy flesh. The Jamaica plum, or golden apple, is another tall tree, with an ash-like aspect (*S. lutea*), with yellowish flower buds which are made into conserve, and an oval drupe. The Spanish plum is the purplish or yellow fruit of *S. purpurea*, widely cultivated in the West Indies. *S. mangifera*, of India, has smooth fruits called wild mango or amra, which is cooked and made into curries, etc.; the tree also yields therapeutical remedies, and a gum resembling gum arabic, and known as hog-gum. The Brazilian *S. tuberosa* not only has a fruit employed in that country as a febrifuge, but is said to produce aerial roots, that, upon touching the soil, form black hollow cellular tubers, containing about a pint of water, which, although intended as a reservoir for the tree in dry weather, serves travelers also.

SPONGE, the horny skeleton, formed of keratose, or spongin, produced by certain animals living in the sea and of very low grade in the scale of life. Down to a quite recent period they were classified as colonial *Protozoa*, the lowest group of animals; but all naturalists now treat them as separate phylum under the name *Porifera* (or *Spongiaria*), given to them because of the water-pores with which they are provided in such abundance. These pores are ordinarily and chiefly of two kinds, both opening into the internal or digestive canals and passages which everywhere ramify through the mass of the sponge. There are large openings (oscula) relatively few in number, often guarded by special protective devices such as circles of spicules or muscles capable of contracting the orifice, and much more numerous small pores everywhere perforating the surface. The latter are inhalent pores or inlets, which admit water to the internal passages, from which it escapes through the former. A constant current is induced by the activity of countless flagella or little living lashes, generally confined to definite enlargements of the canals known as ciliated chambers which constantly beat the water and drive it ever onward in one direction. This current is a veritable life-giving one to the sponge, bearing into the digestive cavities not only the minute organisms upon which the sponge animal feeds, but also supplying oxygen for respiration, bearing away all waste and excreted substances and assisting in the fertilization of the eggs and the distribution of the larvæ. Some of the simplest sponges, such as are found among those with calcareous skeletons, have but a single osculum at the summit of a sac-shaped or cylindrical body, the walls of which are perforated by many radiating canals, each opening to the exterior by an inhalent pore and ending internally in the central digestive chamber. The walls of such a sponge are composed of the sponge-flesh, formerly called sarcode, together with the skeleton secreted by certain cells of the latter. The flesh consists of three chiefly cellular layers, ectoderm, mesoderm and endoderm. The ectoderm is the sponge-skin and, in the form of a layer of flat cells, covers the whole exterior and lines certain spaces or chambers which are formed in many sponges by a process of enfolding. The endoderm lines all of the truly internal chambers and passages, and consists partly of flattened digestive cells which line the central cavity and parts of the radial canals, and partly of cells which bear each a flagellum with a collar surrounding its base on their free ends, and which are confined to the ciliated chambers. These latter collared and flagellated cells are very characteristic of sponges and are found elsewhere only among the *Protozoa*. Between these limiting layers the mesoderm makes up the great bulk of the sponge-body and consists of a variety of different kinds of cells, of which the most important are the reproductive, from which the eggs and spermatozoa are produced; and the skeletogenous, which secrete the elements of the skeleton.

The great majority of sponges are originally of much the form just described, which may be considered as exemplifying the sponge individual; but as they grow they bud and branch in a very plant-like manner, forming many new oscula and many new partial individuals which often reunite and enclose cavities lined with ectoderm. In this manner colonies of large size and most varied forms are built up, and, simple as the fundamental sponge plan is, there are few animals which present more complex structures and whose morphology has been so late in being correctly explained. The skeletons of sponges may be calcareous or silicious or horny, or the latter may be combined with either of the others. The first two may exist in the form of separate spicules, presenting the most varied shapes characterizing the different genera and species, or built up into a more or less continuous frame-work. Horny or sponging skeletons consist of fibres, almost always interlacing, branching and uniting in a most complete and complex manner, and sometimes strengthened by included silicious of calcareous spicules or granules.

Sponges reproduce asexually by a mode of budding and growth similar to that just described or, as especially exemplified in the fresh-water sponges, by the formation of gemmules which are complexly formed buds protected by a spicule-sheath and capable of developing into a complete sponge colony. They also reproduce sexually by the union of ovum and spermatozoön which develops into a free-swimming ciliated larva (planula), serving not only to reproduce the species but through its activity to distribute these fixed and stationary animals. Except a few small fresh-water species all of the sponges are marine, and occupy all seas from the shores to great depths. It is in tropical and subtropical regions, however, that they are especially prominent. Remains of fossil sponges in great number and variety, some of them representing extinct types, occur in all geological formations from the Cambrian upward.

The phylum *Porifera* has been classified as follows:

Class I. *Calcarea*, including sponges with calcareous spicules, such as the little *Grantia ciliata*, so common on the New England coast.

Class II. *Hexactinellida*, including sponges with silicious usually six-rayed spicules, such as glass sponges and the beautiful Venus' flower-basket (*Euplectella*) of the Japanese and Philippine seas.

Class III. *Desmospongiæ*, including all other sponges with horny or silicious skeletons, and divided into the following three grades: (1) *Tetraxonida*, with tetraxial silicious spicules; (2) *Monaxonida*, with uniaxial spicules, including the fresh-water sponges. (3) *Keratosa*, with a skeleton of spongin fibres, including all of the commercial and related sponges.

The sponges of commerce come from the eastern Mediterranean Sea, the West Indies, and the coasts of Florida and Central America. In the Grecian Archipelago, Crete, Cyprus, on the coasts of Asia Minor, Syria, Barbary and the Bahama Islands, sponge fisheries constitute a very important industry. The finest sponges are obtained in Turkish waters. The fishing season commences in May and closes in September or October. Diving is practised and is carried on in a rude, primitive manner. The diver, who has no dress, seizes hold of a large stone, to which a line is attached, and sinks by means of it to a depth varying from 30 to 180 feet. Keeping hold of the rope, he tears the sponges off the rocks within his reach and places them in a net; when he has secured a netful he signals by means of the rope to be drawn up.

Modern diving dresses have been introduced successfully in some places. The West Indian trade is annually increasing and the fishing industry gives employment to 500 boats and over 2,000 persons. The Bahamas and the coast of Florida are the best fishing grounds.

Florida is the only State in the Union which has a sponge-fishery, and there it is confined to the southwestern part of the coast, along the reefs and to the extensive rocky shoals that lie between Saint Mark's and Anclote Keys. The former is known as the Key ground, with its centre at Key West, the latter as the bay ground with its centre at Tampa Bay.

Nearly all of the sponges used in the United States were brought from the Mediterranean till 1852, when attention was called to the immense numbers that were growing in Florida waters. As soon as it was found that the quality of these compared favorably with those of Europe the merchants and fitters-out of vessels of Key West engaged very actively in the business of placing them on the market. At first the best qualities were bought from the fishermen at the rate of 10 cents per pound. As Mediterranean sponges became scarce and costly the Florida sponges came into more and more demand and their value increased proportionately. After about 18 years' fishing on the known ground the supply began to fail. Then, in 1870, a new area of ground, larger than the old one, was discovered, and this gave a new impetus to the trade. In that year Appalachicola sent out a small fleet of sponge vessels which has since been largely increased and the industry has been energetically pursued with good results.

The methods employed in the fishery differ greatly from those employed in the Mediterranean. Small vessels, carrying crews of from 5 to 15 men, are fitted out for trips of from four to eight weeks on the sponge grounds. The crews are paired off into small rowboats, or "dingies," to catch the sponges. One man stands in the stern, sculling the boat, while the other kneels in the bottom amidship, leaning over the side and scans the bottom of the sea by the aid of a water-glass. When a sponge is sighted the boat is stopped and the kneeling man uses a three-pronged hook, attached to a slender pole 30 to 50 feet in length, to secure it. Considerable dexterity is required of both men. To cure the sponges they are first spread about the vessel's deck in their natural upright position, so that they will die, and while decomposing allow the softened animal matter to run off freely. When they have been several days in this position they are taken to the shore and thrown into the water in little pens called "kraals" (corrals) where the remaining substance is soaked and squeezed out, after which the sponges are removed at intervals and beaten with a stick to facilitate the process.

Although most actively prosecuted during the summer, sponge fishing is now followed more or less throughout the year, the vessels beginning their trips in January and working the different beds successively from north southward. The state of the weather greatly affects the result of the fishery. In some years it has been a complete failure, while in others it has been very profitable, always owing to the weather. As the natural beds of sponges have become scarcer prices have advanced, so that even if a vessel does not secure as large a quantity in a given time as formerly the financial result is about the same.

Several varieties of sponges are caught in Florida waters. There are first, sheep's wool, which sell for $2 to $5 a pound; second, yellow sponges, which sell for 50 to 60 cents per pound, and third, grass sponges, which are coarse in texture and not durable, and sell for 15 to 25 cents per pound. Other coarse grades are boat and glove sponges. When these are marketed they are trimmed and cleaned of sand and shells and then pressed into small bales of 100 to 120 pounds each, in which form they go to the wholesale dealers. The yellow sponge especially is subjected to a bleaching process to improve the color, but the process ordinarily employed greatly weakens the fibre.

Owing to the rapidly decreasing supply of the finer grades and the rising price the problem of propagating sponges artificially has been taken up seriously by the United States Bureau of Fisheries. It has been found that sponges may be raised successfully both from the egg and from cuttings, but, owing to the much shorter time required for the latter to reach a marketable size, the first method has been abandoned. The technical problems of sponge raising have been largely solved and there is every promise that their culture on a commercial scale can be undertaken in the near future and that the depleted grounds will be restocked.

The Florida sponge fisheries employ about 2,245 persons, with 156 vessels and other apparatus valued at $594,598. The average annual product aggregates 418,125 pounds of all kinds of commercial sponges, which sell for $567,685. To this total, sheep's-wool sponges contribute 181,311 pounds, valued at $483,263.

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SPONGE-CUCUMBER. See Fibre.

SPONSORS, in the American Church, those persons who at the solemn administration of baptism make profession of Christian faith on behalf of the baptized. The sponsors are also called godfathers and godmothers of the neophyte; and as the sponsors are regarded as having contracted a spiritual relationship among themselves and with their godchild, they used also to be called godsips (gossips). Sponsors assist at the baptism of adults as well as of infants; but in the baptism of adults those to be baptized, not the sponsors, make answer to the questions put by the minister of the sacrament, «Dost thou renounce the devil and all his works,» etc. By a decree of the Council of Trent two sponsors at most are permitted, a male and a female. In the Anglican Book of Common Prayer it is prescribed that for every male child to be baptized two godfathers and one godmother shall assist, and for every female child one godfather and two godmothers; the same rule applies in the baptism of adults.

SPONTANEOUS COMBUSTION. See Combustion, Spontaneous.

SPONTANEOUS GENERATION, the doctrine that living matter may originate spontaneously, that is, out of non-living matter. The sudden appearance of living things in dead bodies, as of maggots in flesh, and mold on vegetables, was formerly accounted for by regarding them as the direct products of the decay or putrefaction in which they occurred, through some unexplained process. The Italian experimenter, Spallanzani (q.v.), first indicated the probability of the source of these growths being living things or their germs pre-existing in the atmoshpere. He found that when he bound organic solutions, as beef-broth or an infusion or «tea» of hay in a vessel closed against the admission of air, no appearance of living beings, or any evidence of «generation» followed; and the same freedom continued when the air which entered vessels containing fermentable solutions was made to pass first through sulphuric acid, through redhot tubes, and through cotton-wool. That the air does actually contain large quantities of minute organic bodies was demonstrated by Tyndall in his efforts to obtain optically pure atmosphere, and this explains why preserved meats keep for any number of years if properly closed, since, after their thorough cooking, the apertures are hermetically sealed while steam is still escaping, the entrance of atmospheric air with its contents being thus prevented. Lister's antiseptic treatment in surgery is based on the same hypothesis.

But while spontaneous generation is untenable as an explanation of phenomena now in progress, science knows nothing of the original development of living things. Some scientists have held that life comes to the earth from other planets by light pressure moving excessively minute forms. Others have advanced the theory that there is a life element in nature not appreciable to man's five senses, but which under right conditions brings vegetable, animal and human life into matter. Until we know what life is no theory of spontaneous generation will maintain. Evolution is incomplete as a scheme of the universe without the hypothesis of spontaneous origin of living things from inorganic matter. Therefore, many regard life as a problem to be solved only by occult means or by the reincarnated man after the death of his physical body. This is a matter in which chemistry must be consulted as well as biology; and the opinions of thinkers in respect to it — in general an attitude of waiting for more light — may be found under such heads as Animal; Antiseptic; Bacteria; Evolution; Life; Protozoa.

SPONTINI, spŏn-tē'nē, **Gasparo** («Luigi Pacifico»), Italian composer: b. Majolatti, Italy, 14 Nov. 1774; d. there, 24 Nov. 1851. He was educated at the Conservatorio della Pietà d'Turchini at Naples and at 17 produced his first opera, ‘‘Puntigli delle donne,’ which met with immediate success. He went to Paris in 1803, was appointed musical director to the Empress Josephine in 1807, and in 1810 became director of the Italian Opera. In 1820 he accepted the position of court composer and general musical director at the court of Prussia and entered upon a brilliant career at Berlin. His intense jealousy of Weber aroused popular feeling against him in the latter years of his sojourn in that city, and in 1841 he was removed from office though retaining both title and salary. He had been elected one of the five members of the Academie des Beaux Arts at Paris in 1839 and in 1842 he returned to that city. His operas met with continued and brilliant success and he is generally considered the greatest composer in French tragic opera between Gluck and Meyerbeer. His operas include 'L'eroismo ridicolo' (1797); 'La vestale' (1807); 'Nurmahal' (1822); 'Alcidor' (1825); 'Agnes von Hohenstaufen' (1829), etc.

SPOOL, a small cylinder, usually of wood and with a hollow centre, with expanding ends, on which thread, cord or yarn is wound; also any small creel, reel or bobbin used for winding. Machines for winding thread on spools are termed spooling machines or spoolers.

SPOONBILL, a wading-bird of the family *Plataleidæ,* closely related to the ibises, from which the group differs principally in its straight grooved bill, which is quaintly flattened and expanded at the end. The three genera, *Platalea, Ajaja* and *Platibis,* comprise about eight species found in all warm countries. The only American species is the roseate spoonbill (*Ajaja ajaja*). At present it is found throughout South America and northward into the South Atlantic and Gulf States, but formerly ranged to Virginia and Illinois. The general form is heron-like but stouter; the length somewhat less than three feet, the wing expanse about four and one-half feet; the color is white tinted with rose, which becomes quite deep on the under parts, with rusty yellow patches on the tail and sides. The head is bald and variegated with black, green, yellow and orange colors; the bill similarly colored with the addition of blue; the legs and iris red. Young birds lack the rosy tints and have the head fully feathered. This singular and brilliant bird lives gregariously in wooded swamps, and is still abundant in parts of South America and the more inaccessible parts of Florida, but has been exterminated in many places where it was formerly plentiful. They wade in the water and sweep their bills sideways through the mud in search of fishes, frogs, crustaceans, mollusks, insects and worms, upon which they feed. They are strong but heavy in flight and are able to swim somewhat. Besides their harsh cry they produce a clattering noise by snapping the bill like storks. Nesting takes place in colonies, the nest being constructed of twigs in trees and bushes. The three white, rough, elliptical eggs, more than two and one-half inches in length, are laid in April. The European spoonbill (*Platalea leucorodia*) is widely distinguished throughout southern Eurasia, but formerly bred in England. Except that the head is crested and the color chiefly white it closely resembles our species in appearance and habits.

The name spoonbill is also given to a duck (see SHOVELER), and to a sandpiper (q.v.).

SPOONER, John Coit, American legislator: b. Lawrenceburg, Ind., 6 Jan. 1843. He removed with his parents to Madison, Wis., in 1859, was graduated from the University of Wisconsin in 1864, and then enlisted as a private in the Union army. He was mustered out of service as brevet-major, and in 1870 established himself in a law practice in Hudson, Wis. He was elected to the State legislature in 1872, served in the United States Senate in 1885–91, and again from 1897–1907, resigning in March 1907, and engaging in the practice of law at No. 14 Wall street, New York City.

SPORADES, spŏr'a-dēz, either of two groups of islands east of Greece, which have been known by various names at different periods. The Northern Sporades lie east of the Gulf of Volos, and their modern names of the larger areas are (in the order of size) Skopelos, Skiathos, Khilodromia, Pelagonisi and Giuri. They have a total area of 180 square miles, and about 13,000 inhabitants. Every householder on the islands is said to own a ship or boat. The Southern Sporades lie in the Jesaireh-Bahr-i-Sefid Archipelago, east of the Cyclades and south of Asia Minor, Icasia, Astrophalia and Leros are the largest, while Creti, Rhodes and Patmos are the most famed. The largest population is in Icaria (8,000) and Calymnus (7,000). See PATMOS.

SPOROBOLUS. See GRASSES IN THE UNITED STATES.

SPOROGONY, a form of reproduction by spores. See SPOROZOA.

SPOROPHYTE, Evolution of. Some botanists are still disputing in regard to those earliest stages in the evolution of the sporophyte which are found in the algæ and fungi; but there is complete agreement that in all plants from the liverworts and mosses to the sunflowers and orchids the sporophyte begins with the fertilized egg. (See ALTERNATION OF GENERATIONS). Leaving out the algæ and fungi and beginning with the liverworts, the evolution of the sporophyte can be traced with more or less certainty. Before considering the details of development, it may be said that, in such early stages of evolution as are seen in the liverwort and mosses, the sporophyte has no leaves or roots and is dependent upon the gametophyte throughout its lifetime. In the ferns and their allies, the sporophyte is dependent upon the gametophyte during its early embryology, but soon develops leaves and roots and becomes completely independent of the gametophyte, which then dies and disappears. In the seed plants, the gametophyte is the parasitic generation and contributes very little to the sporophyte, except during the first few divisions of the fertilized egg. Several of the most fundamental features in the evolution of the sporophyte are seen in the liverworts. In *Riccia,* one of the lower liverworts, the sporophyte is a small, globular body about one-sixteenth of an inch in diameter, and consists of a central mass of spores surrounded by a single layer of cells (Fig. 1. A). The significant fact is that the entire product of the fertilized egg, except a single, protective outer layer of cells, produces spores. Theoretically, the earliest sporophyte should be one, all of whose cells produce spores. In *Riccia,* a single outer layer of cells has been diverted from the spore producing function, to serve as a protective layer. Botanists speak of this diversion as the "sterilization of sporogenous tissue." The evolution of the sporophyte is marked by more and more sterilization of sporogenous tissue, so that less and less of the product of the fertilized egg is devoted to the production of spores. In some liverworts, all the spores are derived from one-half of the fertilized egg, all the cells derived from the other half being diverted to a vegetative function. This is shown, diagrammatically, in Fig. 1. *B,* where *s* indicates the spore tissue and *v* the diverted, or vegetative tissue. In most liverworts, even less of the product of the fertilized egg develops into spores, not only one-half, but a large part of the other half being diverted to a vegetative function. This diverted portion forms a "foot" which acts as an absorbing organ, and a stalk, which becomes much elongated and places the spores in a more favorable position for dispersal when they are shed (Fig. 1, *C-f,* foot; *s,* stalk; *sp,* spore tissue). In many forms, even in the spore region, some of the cells become diverted to a nutritive function or aid in the dispersal of spores. In *Anthoceros,* a much studied liverwort, there is a still further sterilization of sporogenous tissue, a central column being diverted to vegetative purposes, so that the spore tissue forms only a thimble-shaped mass, the lower part of which is shown, in longitudinal section, in Fig. 1, *D.* In this case, the youngest spore tissue is at the bottom and the mature spores higher up, a continuous growth in the lower portion resulting in somewhat prolonged period of spore production. In the mosses, there is still further sterilization, so that a comparatively small portion of the sporophyte produces spores. In all these sporophytes, there is more or less green tissue, so that there is some advance toward independence; but there are no leaves and the sporophyte lives and dies with its foot attached to the gametophyte. The simplest form among the ferns and fern allies has a root, stem and leaf, and so is independent. There is no form intermediate between a sporophyte without a leaf and a sporophyte with a fairly well developed leaf. Consequently, the origin of the leaf is still a problem. In the ferns, the spore tissue is not only greatly restricted, appearing only as the "fruit dots" on the underside of the leaf, but it often appears late in the life history of the plant. In the flowering plants, there is still less spore tissue and it may appear still later in the development of the plant. In some of the cycads, the plant may reach an age of 25 years, or even more, before any spore tissue is produced. There is such a tremendous difference between a flowering plant and the small, simple sporophyte of *Riccia,* that it hardly seems possible that the large, complex form could represent a final stage in an evolution resulting from a progressive sterilization of sporogenous tissue. However, this is the most generally accepted theory of the evolution of the sporophyte. Consult Bower, F. O., 'The Origin of a Land Flora'; Campbell, D. H., 'Mosses and Ferns.'

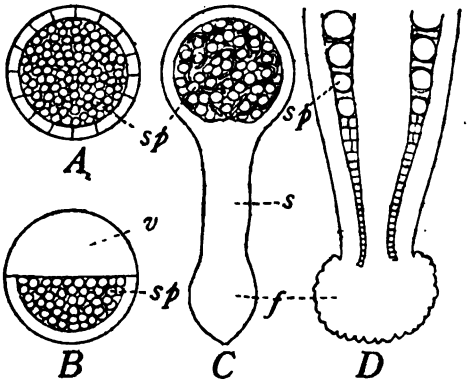

FIG. 1.

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SPOROZOA, a group of protozoa, ranked as a class or more recently as a phylum, which is composed exclusively of parasitic species. They are characterized by complete absence of structures common in free-living protozoa, viz. (1) locomotor processes, pseudopodia, flagella and cilia, (2) openings for taking in solid food or ejecting waste, so that nutrition is purely osmotic, and (3) contractile vacuoles. The life cycle always includes a period in which a large number of spores is produced, and usually two such periods alternate; in one spores are produced asexually by schizogony and in the other by a so-called sexual process (sporogony). These two occur in different organs if not in different hosts so that alternation of generations is regularly associated with alternation of hosts. The development is often extraordinarily complex and no decision as to position or relationships can be reached until the life history is worked out. As this has been done in but few cases the classification and description of the group is subject to constant and marked changes. The sexual phase which may involve isogametes or heterogametes is regarded as more significant than the asexual in deciding relationships.

The class Sporozoa, as originally conceived by Leuckart (1879), embraced not only the Gregarinida, Coccidioidea, and Hæmosporidia which later Schaudinn grouped together as Telosporidia, i.e., those forms producing spores at the close of a stage in the life cycle; but also the Neosporidia which produce spores continuously. The latter which have amœboid spores and one or more polar capsules, are now grouped in a separate class, the Cnidosporidia, by many. They include the orders Myxosporidia, Microsporidia, Actinomyxidia, Sarcosporidia and Haplosporidia.

The Gregarinida are chiefly arthropod parasites. They begin the asexual stage as intracellular parasites in the intestinal wall and desert the cells to become adult in the intestine of the host. They are elongate and the cell is often divided into two regions by a cross partition. The gametes are similar or dissimilar.

The Coccidioidea parasitize epithelial cells of vertebrates particularly in the alimentary canal and its glands. In form they are spherical or nearly so and without differentiated ecto- and endoplasm. The host cell shrinks as the parasite grows until it is reduced to an empty cyst membrane within which the parasite breaks up into a number of crescentic spores surrounding a central residual mass. By rupture of the membrane these merozoites are scattered to infect new cells. At times some stimulus, perhaps excessive infection, leads to the production of micro- and macrogametes which fuse in pairs to form sporoblasts and these encysting became sporocysts in which are produced sporozoites. The latter are the agents by which new hosts are infected and their production takes place usually outside the host. The Coccidioidea cause serious epidemics in rabbits, hares and other animals; they occur in many hosts, even including man.

The Hæmosporidia are clearly coccidia which have been adapted for life in the blood. The asexual stage is amœboid in the red blood corpuscles where merozoites are produced that infect other corpuscles, repeating the process until gametes are formed that await a change of host to find opportunity for further development. This is given by withdrawal of the blood into the stomach of some biting insect where the gametes complete their development and fuse. The sporoblasts and in them the sporozoites are formed in the wall of the insect's stomach and when the sporozoites are set free they penetrate the salivary gland and proboscis by which in the act of biting they are introduced into a new host. (For further details and illustration see article Plasmodium). The most famous members of this group are the organisms producing malarial fevers in man of which there are at least three distinct types. Other species occur in birds and related genera in Amphibia, fishes and reptiles. The mosquito (q.v.) is the inoculating agent for malarial fevers, and since it shelters the sexual generation must be considered the primary host whereas man is the secondary. A leech is believed to play a similar rôle for certain species parasitic in fish. Probably the most widely known disease among domestic animals which is caused by a member of this group is Texas fever in cattle, transmitted by the cattle ticks. See Rinderpest.

The Myxosporidia are practically exclusively fish parasites. Certain forms are common in the gills, others in the skin, where they form conspicuous masses. Less well-known forms inhabit the gall bladder or form ulcers in the muscles and are the cause of serious diseases. The Myxosporidia possess polar capsules which resemble much the nettling cells of Cœlenterata.

The Microsporidia are not well known despite the fact that they are of conspicuous economic importance since one species is the cause of Nosema, a serious disease of the honey bee and another produces pébrine of the silkworm; the latter was the subject of early important studies by Louis Pasteur.

The Sarcosporidia are found parasitic in the muscle cells of vertebrates and are sufficiently large to be conspicuous to the naked eye. They were originally designated Miescher's or Rainey's corpuscles and occur occasionally in man. A serious Australian disease of sheep known as «scrapie» is caused by one of these forms; it is also found in North America. By dissecting Sarcosporidia out of host tissue and subjecting them to chemical study a protozoan toxin named Sarcosporidin has been isolated; this is the first discovered in this group.

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SPORRAN, a pouch or large purse worn by the Highlanders of Scotland in full dress, and by men of the kilted regiments. It is usually made of the skin of some animal, with the fur turned out, and often ornamented with silver and stones. It is worn in front of the kilt. The name is the Gaelic for purse.

SPORTING RECORDS. See Sports.

SPORTS, The Book of, a popular name for the proclamation issued in 1618 by James I, and ordered to be read in all churches, wherein it was declared that dancing, archery, May-games, morrice-dances, leaping, vaulting and other such games were lawful on Sunday after divine service, but prohibiting bear-baiting, bull-baiting, bowling and interludes. The order to read this declaration was largely disregarded, but in the reign of Charles I it was republished (1633) and enforced with severity. This created great outcry and opposition and in 1644 the Long Parliament ordered all copies of it to be collected and publicly burned.

SPORTS: THEIR DEVELOPMENT, SPEEDS AND RECORDS. In the state of savagery man's life depended on his agility in running, jumping, climbing and throwing of projectiles. In the high condition of civilization of ancient Greece the natives considered prowess in the arts of speed and endurance as evidence of superiority in manhood and they held their athletic sports in reverence as well as with enthusiasm. In their Olympic or Pan-Athenaic Games the entire populace partook. A proof of all-round manly vigor was given in their *pentathlon*, which consisted of a series of five games contested by the same rivals — running, jumping, wrestling, disc-throwing and javelin throwing. In recent years we have established a renewal of these ancient sports as well as that of the Marathon races. The latter covers a distance of 26 miles, 385 yards, and some of the records are as follows: Olympic Marathon, held at London in 1908, was won by the American John Hayes in 2:56:02 2–5; in the same year at Madison Square Garden, run by the Italian Dorando against Hayes, the former won in 2:44:20 2–5. J. T. Crowley of the Irish-American A. C., won the race at Yonkers, same year, in 2:49:16 2–5. In the amateur race from Rye to Columbus Circle, New York, Matthew Maloney of the Trinity A. C. won in 2:36:26 1–5. Of marvelous interest would be a comparison of the speeds and records achieved in sports by the ancient Greeks and Romans with those of our day. Only a few records of classic day sports have come down to us, however, and these pseudo-records can only amuse and surprise us. In leaping or long jump (termed *halma*) the ancients used weights (called *halteres*) like our dumbbells to increase their capacities, and we have the record attributed to a certain athlete named Phayllus of Kroton of 55 feet. This looks like the measure of our hop, skip and jump. And we are never likely to achieve what these sporting reporters recorded with their elasticity of statement. Our records are scientifically measured and corroborated by expert unbiased judges or are ignored as «unofficial.»

The outcome of the supreme efforts of man in recent days in running, walking and some other contests will be found in the last section of this article under the head «World's Sports Records.» These tables afford a record of the advance man has made in speed by science and physical development. The following statistics give the various records to date.

TROTTING HORSES.

Trotting.— The «foundation» horses or first sires of the American trotting track were the imported stallions Messenger and Justin Morgan (former died 1808; latter 1821). Hambletonian, a descendant of Messenger, headed a great family of thoroughbreds, and the Justin Morgan breed includes many noted trotters of this day. Of old records that can be relied on we have: Three miles under saddle, Screwdriver, 1828, 8:02; three miles in harness, Topgallant, 1829, 8:11; 1834, Edwin Forrest, one mile under saddle in 2:31½; same year Sally Miller, one mile in harness in 2:37; 1845, Lady Suffolk, one mile in harness in 2:29½; 1849, Pelham, one mile in 2:28. Noted one mile high wheel records are: Maud S., 1885, 2:08¾; Sunol, 1891, 2:08¼ (kite track); Palo Alto, 1891, 2:08¾ (kite track); Jay-eye-see, 1884, 2:10. In 1892 the bicycle sulky arrived.

Records under saddle are: One mile, Great Eastern, 1877, 2:15; two miles, George M. Patchen, 1863, 4:56; three miles, Dutchman, 1839, 7:32½; four miles, Dutchman, 1836, 10:51.

Noted one mile trotting records with running mate are: Ayres P. (against time), 1893, 2:03½; Frank (in a race), 1883, 2:08½. *One mile team* records are: Monk and Equity, 1903, 2:08; Leaf and Sally Simmons (in a race), 1894, 2:15¼; Uhlan and Lewis Forrest, 1912, 2:03¼. For world's records see last section of article.

Harness speed (one mile): Boston Blue, 1818, 3:00; Bull Calf, 1830, 2:47¾; Edwin Forrest, 1838, 2:36½; Dutchman, 1839, 2:32; Lady Suffolk, 1845, 2:29½; Pelham, 1849, 2:28; Highland Maid, 1853, 2:27; Flora Temple, 1859, 2:19¾; Goldsmith Maid, 1871, 2:17; Rarus, 1878, 2:13¼; Maud S., 1880, 2:10¾; Jay-eye-see, 1884, 2:10; Maud S., 1885, 2:08¾; Nancy Hanks, 1892, 2:04; The Abbott, 1900, 2:03¼; Cresceus, 1901, 2:02¼; Lou Dillon, 1903, 1:58½ (with shield); Uhlan (with running mate), 1913, 1:54½. In 1892 the bicycle sulky brought the record down quickly and in 1903 we meet the supposed impossible two-minute horse, Lou Dillon. For world's records see last section of article.

PACING HORSES.

These were brought into popularity when the country was young and roads bad; the saddle-horse of easy gait was then of great use. The Rhode Island pacers, called Narragansetts, are claimed to be from Spanish (Andalusian) stock. The Kentucky and Tennessee pacing horses are said to have come from Canada, and they were never trained to harness till recent dates. Records to 1902 are: Star Pointer, 1:59¼; Dan Patch, 1:59½; Prince Alert, 2:00, etc. The dirt shield aided Dan Patch to attain 1:56¼ in 1903. For fastest speeds see table of «World's Records» in last section of article.

YACHTING RECORDS.

Our earliest yachting records take us back to 1801 when Capt. George Crowninshield of Salem, Mass., got Christopher Turner of that town to build him *The Jefferson*, a 22-ton sloop yacht. This craft in 1812 became a privateer, then for many years a fisherman. George's brother, Benjamin, then Secretary of the Navy, under President Madison, had the *Cleopatra's Barge*, with a 93-foot waterline, of nearly 192 tons, 11 feet 5 inches depth of hold, built at a cost of $50,000. In this pleasure craft Captain Crowninshield made, in 1817, a cruise to European waters, returning same year. Between 1830 and 1840 we find numerous pleasure craft in New York and Boston, with John C. Stevens (owner of Hoboken Island on the Hudson), George Crowninshield and R. B. Forbes leaders in the sport; but it was chiefly with ship-owning families. George Steers, son of an English shipwright, modeled the schooner yacht *La Coquilla*, 44 feet in length, and (in 1847) modeled and built the schooner *Cornelia* (74 feet). Then were constructed by him the schooner *Signet* (53 feet, 2 inches) and the sloop *Una* (64 feet). This was probably the commencement of designing boats on special lines as pleasure craft. This «boom» in yacht-building started the New York Yacht Club in 1844, and Stevens and Steers are considered the fathers of American yachting. In 1849 Steers modeled the *Mary Taylor* as a pilot-boat on radically novel lines so successfully that others followed on his new plans. On 17 July 1845, two days after the New York Yacht Club built its (wooden) clubhouse at Castle Point, Hoboken, the first regatta was sailed (Robbins-Reef to a Bay Ridge mark, past a Stapleton mark, around Southwest Spit buoy and return) with eight entries and *Cygnet* winning in 5:23:15. Regattas continued annually. The Southern Yacht Club of New Orleans was organized in 1849; North Carolina Yacht Club in 1854; Brooklyn Yacht Club in 1857, and Jersey City Yacht Club the following year. Between 1866 and 1872 yachting had become so popular that general clubs were formed all along the Atlantic Coast. In 1851 George Steers designed and a «syndicate» had built an ocean-going $30,000 yacht in pilot-boat style, 101 feet long over all, drawing 11 feet, to enter a yacht race around the Isle of Wight, England, following an invitation from the British. The yacht was christened *America*, and sailed to Havre in 21 days. The story of *America's* victories belongs elsewhere, but Commodore Stevens and associates brought the Royal Yacht Squadron's Cup to New York, where it has resided ever since. The *America's* model and sails established a new departure, followed by British as well as American yachts, and the old blunt noses gave way to keen prows (John Scott Russell, British designer, had first advocated these revolutionary changes before the *America's* construction, and Steers had studied the suggestions). But centre-boards prevailed over keel boats for these shallow waters. The cat-boat was a favorite small craft in the 50's of last century, and Capt. Bob Fish designed many for Europe (where they were called «Una» boats) besides large yachts later (*Gertrude, Undine*, etc.). In the 60's John B. Herreshoff and family made Bristol, R. I., noted with his small and larger yachts, then launches and steamers. And James G. Bennett with his *Rebecca* (sloop) racing the *Julia* (recently named *Nirvana*), the centre-board sloop, Boston also became a favorite yachting centre. The great schooner yachts came into vogue after the Civil War (*Fleetwood, Phantom, Palmer, Josephine, Idler*, etc.). And in 1866 Pierre Lorillard had his 201-ton *Vesta* built. Then came the ocean race (winter of 1866) from Sandy Hook to Isle of Wight, *Henrietta* (of J. G. Bennett), *Fleetwing and Vesta* contesting (times, respectively, 13d. 21h. 55m.; 14d. 6h: 10m.; and 14d. 6h. 15m.) over the 3,000 and odd miles course. The 274-ton *Sappho* (keel schooner), built by Poillon Brothers and launched in 1867, was a failure at Cowes races till W. P. Douglas had her altered and made the run to Queenstown in 12d. 9h., a record, and beat Ashbury's *Cambria*. By 1870 schooner racing was the vogue but the «skimming dish» type was coming into its own, with its light draught. The *Mohawk* disaster (costing the lives of owner and family) hurt the large schooner type. The «America Cup» races following do not belong here. In 1871 the Seawanhaka Yacht Club was organized and yacht owners began to take a pride in knowing the technique of the craft, not leaving, as before, everything to the professional designer. Then the English «cutter» type was started in the *Vindex* (1871), and other seaworthy yachts followed, with *Petrel* (1876), *Volante* (lead keel), etc., proved successes; and «Corinthian» principles ruled. The lead keel brought in the narrow type such as *Muriel* (1878). *Mischief* («compromise sloop») of 1892 was cutter type with centre-board. Next came racing by classes (all entered one race), and schooner and sloop entered separate classes. The latter, in the late 70's divided into 70 footers and 50 footers. Hulls of metal started with *Mischief*. In 1881 came *Valkyr*, wider and with less draught, lead keel, centre-board, cutter rigged. *Madge* (10 toner, lead keel) came from Glasgow (1879) as victor in England and Scotland, and, with her great club-topsail, took on a speed that won all New York Harbor events, only to be beaten by *Shadow* (Herreshoff) at Newport. But six victories in seven races hurt the reputation of centre-board sloops and cutter type looked up. Will Fife, Jr.'s, 62-foot *Clara*, narrow cutter, came from Scotland in 1885 and (under Capt. John Burr) defeated everything competing. Burgess was the popular designer now (*America* Cup defenders 1885, 1886, 1887), and yachting was the most popular sport, the races being prolific in classes: 90 feet, 70 feet, 53 feet. Forty-foot waterline boats became the rage (*Baboon, Nymph*, etc.), and the 40-foot *Minerva* came over from Scotland (1888), beating *Liris*. Burgess produced *Gossoon* (keel) and they tied in 10 races. After 1890 the 90-foot class was superseded by the 46-foot waterline craft. Herreshoff's *Gloriana* now became the furor with its abnormal projection of shallow bow, the «forefoot» cut away; then he produced the «fin» keel (1892). Space does not permit discussion of the «small yachting» types (*mosquito*), half-raters, «knockabouts,» etc.

On account of the World War yacht-racing had to fall into disuse after the *Shamrock IV*, contestants, *Vanitie* and *Resolute* had made trial speeds in 1915, but Sir Thomas Lipton renewed his challenge in 1919 and his challenger is expected to be taken from her Erie Basin dock for her next year's race.

Motor Boat Racing.

Competition has been keen in this most modern of aquatic races, and the development in speed is phenomenal. The popular National Power Boat Association championship Gold Cup races (30 miles) show the following winners:

Date	Winner	Owner	Average speed
1912	P. D. Q. II	A. G. Miles	36.8
1913	Ankle Deep	Count Mankowski	44.5
1914	Baby Speed Demon II.	P. Blackton	50.49
1915	Miss Detroit	D. P. B. A	48.49
1916	Miss Minneapolis	M. P. B. A	49.27
1917	Miss Detroit II	D. P. B. A	54.36
1918	Miss Detroit III	Detroit Y. C.	34.10

For other records see World's Records section at end of article.

Steamship Speeds.

Transatlantic Records.— In the days of the fast-sailing packet ships the old *Yorkshire* crossed from Liverpool to New York in 21 days, and *Ashburton* made the passage in 24 days. With our modern «greyhounds» of the ocean the following records show the ever-increasing speed of the liners between New York and Queenstown: 1856, *Persia*, 9d. 1h. 45m.; 1856, *Scotia*, 8d. 2h. 48m.; *City of Brussels*, 7d. 22h. 3m.; 1873, *Baltic*, 7d. 20h. 9m.; 1876, *Germanic*, 7d. 11h. 37m.; 1880, *Arizona* 7d. 7h. 23m.; 1882, *Alaska*, 6d. 18h. 37m.; 1884, *Oregon*, 6d. 11h. 9m.; 1887, *Umbria*, 6d. 4h. 42m.; 1888, *Etruria*, 6d. 1h. 55m.; 1891, *Majestic*, 5d. 18h. 8m.; 1891, *Teutonic*, 5d. 16h. 31m.; 1893, *Campania*, 5d. 12h. 7m.; 1894, *Lucania*, 5d. 7h. 23m.; 1909, *Mauretania*, 4d. 13h. 41m. In 1910 *Mauretania* made the trip from Queenstown to New York in 4d. 10h. 41m. *France* made the passage from New York to Havre, 1912, in 5d. 17h.; *Kaiser Wilhelm der Grosse* crossed from New York to Cherbourg, 1900, in 5d. 16h., and from New York to Southampton, 1897, in 5d. 17h. 8m. The voyage from New York to Plymouth was made, 1909, by *Kronprinzessin Cecilie* in 5d. 7h. 25m. Passage from New York to Naples was made, 1904, in 7d. 16h. 44m. by *Deutschland*. The Allen Line *Virginian* (turbine), 1905, crossed from Moville and passed Cape Race in less than four days.

Of recent years the aim of the great transatlantic steamship lines to reduce passage time and make new records has died out under compelling circumstances. The advance in speed is gained, of course, by the increase of fuel consumption, but that increase is based on a progressive ratio of augmented consumption, and the cost of fuel together with loss of freight space in carrying such enormous quantities brought the competitors face to face with an actual loss, even at the advanced passenger rates on such «express» steamers. The designers of late have expended their energies in increasing the size and carrying capacities of the leviathans and improving the life attractions on board. And the clipping of hours from passage time must be reckoned as an activity passed into desuetude.

Aviation Records.

The permanent success of the Wright brothers' invention was proven in 1905 by long distance flights in England, France and Germany, and the armies of these powers grasped the merits of the revolutionary discovery of flight in heavier-than-air machines for war purposes. The governments aided advancement in the new art so that air squadrons soon entered the conflict when the World War reached its fiercest stage. But the war paralyzed competition in popular races and records have not been accepted by the International Aviation Association since 1914. The enormous impulse in advancing the science of aviation caused by the use of the machines by the belligerent governments becomes clear to us when we read the few wonderful feats performed by the improved types of flying structures. Some former prominent events were: The Paris-to-Madrid race won by Vedrine in 37h. 26m. 12s. in 1911. In 1910 Grahame-White had covered 100 kilometers (62 miles) at Belmont Park in 60m. 47⅗s. or 61.3 miles per hour. The United States army in 1911 had her first intercity race, from New York to Philadelphia (about 83 miles) which was won by L. Beachy in two hours (net time 1h. 50m.), and G. Fourny accomplished in that year 447.3 miles at Buc, France (without stops) in 11h. 29s. Against these records we have in 1918 (when the United States army inaugurated first airplane mail service) the New York to Washington route performed in 3h. 30m. Mail aviators flew last year (with mail) from Paris to London and return in 3h. 10m. In a long series of runs between New York and Washington in 1919 the mail planes have averaged a speed of 70.80 miles per hour. In the revived English aerial Derby, which was interrupted by the war, the course of which is around the suburbs of London, Captain Gathergood, in 1919, won, averaging a speed of 140 miles an hour. T. Sopworth won that of 1912 (in a Bleriot) at an average speed of 59 miles an hour. In 1913 Gustav Hand won it (in a Morane) at an average speed of 76 miles an hour, and an American, W. L. Brock, won the 1914 contest at a speed of 72 miles the hour. For altitude flights January, 1919, Captain Lang, British army, held the record with a height of 30,500 feet. On 28 May this year Adjutant Casale ascended 31,000 feet and on 8 June beat his own record with a flight of 31,168 feet. This record was bettered on 18 September by Roland Rohlfs, whose altimeter registered 34,610 feet. Lieut-Col. Leonhard H. Drennan, of the Air Service, flew from Boston, Mass., to Hazelhurst Field, Long Island, in 83 minutes, a distance of 175 miles, in a DeHaviland four machine. Col. Davenport Johnson and Lieut. H. S. Ormsbee (pilot) of the Air Service flew from Chicago to Selfridge Field, Mich., a distance of 250 miles in 140 minutes, in a DeHaviland four. And in this same year (1919) is realized the ultimate dream of the aviator, flight across the Atlantic Ocean. Under the supervision of the United States navy the naval seaplane NC-4 (piloted by Lieutenant Read) made a flight from Rockaway to Plymouth, England, a distance of 3,926 nautical miles, in 55h. 33m. actual flying time, averaging 70.80 miles an hour while in flight. The entire course and dates are as follows: Rockaway-Chatham (forced to land) 8 May; Chatham-Halifax, 14 May; Halifax-Trepassey, 15 May; Trepassey-Horta (Azores), 1,200 nautical miles, 16-17 May; Horta-Ponta Delgada, 20 May; Ponta Delgada-Lisbon, 27 May; Lisbon-Mondego River, 30 May; Mondego River-Ferrol, 30 May; Ferrol-Plymouth, 31 May. Still more remarkable was the non-stop flight across the Atlantic Ocean, from Saint Johns, Newfoundland, to Clifden, Ireland, made by Capt. John Alcock and Lieut. Arthur W. Brown, 14-15 June, in an English Vickers-Vimy bomber biplane. They made the distance, 14-15 June, 1,980 miles, in 16 hours 12 minutes, at 120 miles per hour.

Railroad Speeds.

As railroading is not a sport, judges have not verified the records we have of the fastest attainments of locomotives and trains. The following are generally accepted as the highest speeds on rails:

Egg Harbor to Brigantine Junction (Philadelphia and Reading), 4.8 miles, in 2m. 30s., averaging 115.20 miles per hour (1904). Crittenden run of «Empire State Express» (1893) of New York Central and Hudson River, one mile in 32s., averaging 112.5 miles per hour. The Plant system is said to have run, in 1901, a train from Fleming to Jacksonville, a distance of five miles, in 2m. 30s., an average of 120 miles per hour. A trial test of steam vs. electric locomotives was made, in 1907, by the Pennsylvania Railroad at Clayton, N. J.; the track was seven-mile curve specially constructed, and speeds were: steam, 93.6 miles per hour against 90 miles electric. Records in long distances are: Eckley to Wray on Burlington Route, in 1902, covering 14.8 miles in 9m., an average of 98.7 miles per hour. Paddington to Bristol, England, 118.5 miles in 1h. 24m., or average 84.6 miles per hour on the Great Western Line in 1904. In 1897 the «Black Diamond Express» (Lehigh Valley Railroad) ran from Alpine, N. Y., to Geneva Junction, N. Y., 43.96 miles, in 33 minutes, an average of 80 miles per hour.

Automobile Races.

Date	Car	Driver	Place	Miles	Average
		Vanderbilt Cup.			
1912	Mercedes	De Palma	Milwaukee	299.54	68.97
1914	Mercedes	De Palma	Santa Monica	294.035	75.60
1915	Peugeot	Resta	San Francisco	300.78	66.29
1916	Peugeot Special	Resta	Santa Monica	294.035	In 3h. 22m. 48s.
		Grand Prize.			
1912	Fiat	Bragg	Milwaukee	409.9	68.4
1914	Mercedes	Pullen	Santa Monica	403.24	77.22
1915	Peugeot	Resta	San Francisco	402.75	56.78
1916	Peugeot Special	Wilcox and Aitken	Santa Monica	403.238	In 4h. 42m. 47s.
		Elgin National.			
1912	Mercedes	De Palma	Chicago	302.5	68.9
1913	Stutz	Anderson	Chicago	301.16	71.05
1914	Mercedes	De Palma	Chicago	401.18	73.05
1915	Stutz	Anderson	Chicago	301.44	77.256

In 1918 a number of races showed the following records: Brooklyn, N. Y., 100 miles, in 50m. 21s. by De Palma in a Packard. Chicago, 100 miles, in 55m. 25s. by Chevrolet in a Frontenac.

In 1919 Ralph de Palma, at Sheepshead Bay in a Packard, made 50 miles in 26m. 23 1-5s. For other records see World's Records tables at end of this article.

Bicycling Records.

Owing to the European War no world championships have been competed for since 1913. Speed records are:

Professional Motor-Paced in Competition.— One mile by McLean in 1.09 1–5, 1903; two miles in 2.19 by McLean, 1903; 26 miles in 29.22 3–5 by Walthour, 1904; 30 miles in 33.52 3–5, by Walthour, 1904.

Motor-Paced Against Time.— One mile in 1.04 1–5 by M. Bedell, 1917; two miles in 2.09 4–5 by Duer, 1909; five miles in 5.18 2–5 by M. Bedell, 1917; 10 miles in 10.59 3–5 by M. Bedell, 1917.

Unpaced Against Time.— One mile in 1.51 by Goullet, 1912; two miles in 4.01 3–5 by Pye, 1910; five miles in 10.38 by Williams, 1909; 10 miles in 23.09 2–5 by Hamilton, 1898.

Amateur Unpaced Against Time.— One mile in 1.55 by Giles, 1908; two miles in 4.09 by Giles, 1908; five miles in 11.00 by Giles, 1908.

Six-Day Race Winners.— 1913, Goullet and Fogler, 2,751 miles; 1914, Goullet and Grenda, 2,758.1 miles; 1915, Grenda and Hill, 2,770.8; 1917, Goullet and Magin, 2.473.4; 1918, Madden and Corry, 1,303.4; 1919, Goullet and Magin, 2,510.

Road Records.— American Amateur with Competition.— One mile in 2.02 by Surman, 1908; two miles in 4.56 1–5 by J. Steinert, 1911; five miles in 12.28 2–5 by J. B. Hawkins, 1908; 10 miles in 23.08 by Thomas Bello, 1915; 25 miles in 1.03.07 by Thomas Bello, 1915; 50 miles in 2.14.00 4–5 by Edwin Jensen, 1915; 100 miles in 5.06.12 by T. La Rossa, 1911; 150 miles in 8.26.27 by J. G. Kopsky, 1912.

Motorcycle Races.

Records will be found in World's Records section end of article.

Athletic Sports.

The maintaining and enforcing of clear-cut amateur conditions surrounding the entries and contests of the various athletic clubs, and the elimination of professionals surreptitiously getting into the ranks, necessitated a unification of clubs and setting up of jurisdiction centred in some body. In England the Amateur Athletic Association (A. A. A.) was founded in 1880 at Oxford, confederating the legitimate clubs. After the New York Athletic Club for three years had managed the amateur championship meeting they had established and successfully carried on, the New York Athletic Club determined in 1879 to give up this management. The club had found the games profitable but the calls for the officers' time was too great in appeals as to decisions on athletic law, information as to the dates of the games, programs, entries, etc. So the New York Athletic Club decided to hand over the conduct of the championship games to a regularly organized association of athletic clubs. Such an association was formed under the title "National Association of Amateur Athletes of America." But abuses crept in and the good name of the amateur sports was endangered. This led to the determination to form a national amateur union of clubs under the title "Amateur Athletic Union of the United States," which was organized in 1888. Reliability of the records is the outcome. As George P. Meade well expresses present conditions: The rules of the records are "timed by at least three skilled timers, distances are accurately surveyed and are remeasured in case a claim for a record is to be made; strict rules are observed to prevent mistake or fraud at the start and finish, and unusual circumstances, such as favoring winds, are noted by judges and referee. Finally the performance is investigated by a committee of the national athletic board of the country in which the race was run, and every circumstance that might affect the validity of the record is discussed before the record is sanctioned. (These precautions apply only to amateur athletics)."

Boxing Records.

Professional Champions. *Heavyweights* (over 158 lbs.): John L. Sullivan, 1890–92; James J. Corbett, 1892–97; Robert Fitzsimmons, 1897–99; James J. Jeffries, 1899–1910; Jack Johnson, 1910–15; Jess Willard, 1915–19; Jack Dempsey, 1919–. *Middleweights* (158 lbs.): Robert Fitzsimmons, 1890–97; Tommy Ryan, 1897–1907; Stanley Ketchel, 1907–08; Billy Papke and Stanley Ketchel, 1908; Stanley Ketchel, 1908–10; Frank Klaus, Mike Gibbons, Ed. McGoorty and George Chip all claim championship from 1911–13; Al McCoy, 1914–17; Mike O'Dowd, 1917–18. *Welterweights* (145 lbs.): Tommy Ryan, 1894–96; Kid McCoy, 1896–97; Billy Smith, 1898–1900; Rube Ferns, 1900; Matty Matthews and Rube Ferns, 1901: Joe Walcott, 1901–04; Dixie Kid, 1904–08; Kid Graves, 1914–16; Jack Britton, 1916; Ted (Kid) Lewis, 1917–18. *Lightweights* (133 lbs.): Jack McAuliffe, 1890–93; Kid Lavigne, 1893–99; Frank Erne, 1899–1902; Joe Gans, 1902–08; Battling Nelson, 1908–10; Ad Wolgast, 1910–12; Willie Ritchie, 1912–14; Freddy Welsh, 1914–17; Benny Leonard, 1917–18. *Featherweights* (122 lbs.): George Dixon, 1892–97; Solly Smith, 1897; Solly Smith and Dave Sullivan, 1898; George Dixon, 1898–1900; Terry McGovern, 1900–01; Young Corbett, 1901–04; Tommy Sullivan, 1904–08; Abe Attell, 1908–11; Johnny Kilbane, 1911–18. *Bantamweights* (116 lbs.): George Dixon, 1890–92; none recognized from 1892–94; Jimmy Barry, 1894–98; none recognized from 1898–1901; Harry Forbes, 1901–03; Frankie Neil, 1903–05; none recognized from 1905–07; Johnny Coulon, 1907–13; Kid Williams, 1914–15; Pete Herman, 1916–18. For earlier champions see under title Prize-Fighting.

Prize-Fighting. *Amateur Champions in 1918, A. A. U. National:* 108-pound class, Joe Wiles, Boston; 145-pound class, James Sullivan, New York; 158-pound class, Martin Burke, New Orleans; 115-pound class, James Tomasulo, New York; 175-pound class, John McMinimen, Camp Devens; 125-pound class, James Fruzetti, Brockton; 135-pound class, Thomas O'Malley, Philadelphia; heavyweight class, Martin Burke, New Orleans. *Metropolitan Association A. A. U.:* 108-pound class, D. Kamins, Clark House A. A.; 115-pound class, James Tomasulo, Elizabeth Y. M. C. A.; 125-pound class, A. Schick, unattached; 135-pound class, S. Mosberg, unattached; 145-pound class, J. Sullivan, Union Settlement; 158-pound class, S. Lagonia, Bronx Athletic Club; 175-pound class, G. Schalk, unattached; heavy-weight class, G. Schalk, unattached. *New England A. A. U.:* 115-pound class, Bob Josephs, Boston; 158-pound class, Billy Rush, Boston Navy Yard; 108-pound class, Joe Willis, Chelsea; 125-pound class, Charles Parker, Boston; 135-pound class, Joe Melanson, Boston; 145-pound class, Al. Lacy, Chelsea; 175-pound class, Billy Rush, Boston Navy Yard.

Baseball Records.

This most popular of American games suffered with the rest through the World War. And the «Work or Fight» regulations placed the professional league members, in 1918, among the «non-essential» classes of workers. The National, American and International leagues closed 2 Sept. 1918, the pennant winning clubs continuing the world series only. Boston won, defeating Chicago four games to one.

PREVIOUS WORLD BASEBALL CHAMPIONSHIPS.

Event	Winners	Games won	Losers	Games won
1913.....	Philadelphia (A. L.)........................	4	New York (N. L.)..........................	1
1914.....	Boston (N. L.)..............................	4	Philadelphia (A. L.)......................	0
1915.....	Boston (A. L.)..............................	4	Philadelphia (N. L.)......................	1
1916.....	Boston (A. L.)..............................	4	Brooklyn (N. L.)..........................	1
1917.....	Cnicago (A. L.).............................	4	New York (N. L.)..........................	2
1918.....	Boston (A. L.)..............................	4	Chicago (N. L.)...........................	2
1919.....	Cincinnati (N. L.)..........................	5	Chicago (A. L.)...........................	3

Billiards and Pool.

These are probably the most internationally popular indoor games. Already mentioned in the 16th century billiards has retained its hold among most civilized nations.

Best Billiard Record Runs. Professional: 312 at 18.2, Calvin Demarest, Chicago, 1910; 155 at 18.1, Willie Hoppe, Philadelphia, 1910; 246 at 18.2, Maurice Vignaux, Chicago, 1883; 303 at 14.1, Willie Hoppe, New York, 1914; 85 at straight cushion-caroms, F. C. Ives, Boston, 1906; 398, champion's game, Paris, 1882; 2,196 at English billiards, George Gray (Australian), at London, 1911. *Amateur:* 175 at 18.2, L. Lerolle, Paris, 1908; 202 at 14.2, Calvin Demarest, Chicago, 1908.

Best Record Averages. Professional: 135¼ at 18.2, Willie Hoppe, Chicago, 1914; 40 at 18.1, Jacob Schaefer, Chicago, 1898; 10 at straight cushion-caroms, J. Schaefer, New York, 1883; 37.97 at champion's game, G. F. Slosson, Paris, 1882; 52 at 14.1, George Sutton, Baltimore, 1914. *Amateur:* 57.14 at 14.2, Calvin Demarest, Chicago, 1908; 33.33 at 18.2, Lucien Lerolle, Paris, 1903.

Pool: under new rule, best run — 74, Morton Phillips, Chicago, 1913; in amateur city championship — 59, Alfredo de Oro, New York, 1913 (professional).

National Amateur Championships: Joseph Mayer, Philadelphia, 1913; Edward W. Gardner, Montclair, N. J., 1914; Joseph Mayor, Philadelphia, 1915; E. W. Gardner, 1916; Nathan Hall, Boston, 1917; Corwin Huston, Detroit, 1918.

Trap Shooting Records.

Recent winners of the Grand American Tournament are: W. E. Phillips, 1912; M. S. Hootman, Dayton, 1913; W. Henderson, Dayton, 1914; L. B. Clark, Chicago, 1915; J. F. Wolf, Saint Louis, 1916; C. H. Larson, Chicago, 1917; F. S. Tomlin, Chicago, 1918.

Chess Records.

This game is very ancient and ascribed to India, China, Persia and even Egypt. There was a chess club at Slaughter's coffee house, London, in 1747, and M. F. A. Danikin («Philidor»), who died 1795, played three matches blindfolded at the Salopian. The London Chess Club was founded in 1807. Herr Paulsen (1861) played 10 games at once, winning five, three being drawn and one not played out. International Chess Congresses were started in 1851. Noted players of the 19th century were Howard Staunton, J. J. Lowenthal, J. H. Zukertort, etc. The World War greatly restricted activity in the game, Europe being entirely out of the game. J. R. Capablanca, of Havana, in 1918 showed his marvelous powers in 38 games played at the Manhattan Chess Club, winning 33, with 5 draws. The Manhattan Chess Club championship of 1918 was won by Oscar Chajes, 6–1, who also won at the Winter Meet of the New York State Association. In the International Tournament of 1918 Capablanca was the winner.

Football Records.

This is probably the second most popular sport in both the United States and England. Chester, England, had had a great annual football game up to the 16th century, when the match was discarded in favor of foot-races patronized by the city authorities. Eton, Rugby and Soccer rules have their advocates, but the latter style of play seems to be favored at present. In 1916 an all-American team of the United States Football Association went to Scandinavia where they won three games out of six, lost one and two were drawn. In 1917 the National Challenge Cup was won by the Fall River Rovers. Previous winners of this and other games were:

NATIONAL CHALLENGE CUP.

1913	True Blues, Paterson
1914	Bethlehem F. C., Bethlehem
1915	Scottish-Americans of Newark
1916	Bethlehem F. C.
1917	Fall River Rovers
1918	No games

INTERCOLLEGIATE LEAGUE.

1913	Harvard
1914	Pennsylvania
1915	Haverford
1916	Pennsylvania
1917	Pennsylvania
1918	Games canceled

YALE–HARVARD FOOTBALL.

1913	Harvard
1914	Harvard
1915	Harvard
1916	Yale
1917	No games
1918	No games

Basketball Records.

Intercollegiate League Winners: 1912, Columbia; 1913, Cornell; 1914, Cornell; 1915, Yale; 1916, Pennsylvania; 1917, Utah; 1918, Pennsylvania.

Lawn Tennis Records.

National Championship: 1913, M. E. McLoughlin; 1914, R. Norris Williams; 1915, Wm. M. Johnston; 1916, R. Norris Williams; 1917, no contest; 1918, Robert Lindley Murray. *Davis Cup Contests:* 1913, U. S. A; 1914, Australasia; 1915, no contests during World War.

Wrestling Records.

Intercollegiate Championships (by points): 1912, Cornell; 1913, Cornell; 1914, Cornell; 1915, Cornell; 1916, Cornell; 1917, Cornell; 1918, Penn State.

Professional International Tournament: 1915, Zbyszko won final bout at New York City.

Fencing Records.

National Championship Amateur Fencing League of America (foil): 1912, S. Hall; 1913, A. V. Z. Post; 1914, Dr. S. D. Breckinridge; 1915, Lieut. Oliver A. Dickinson; 1916, A. E. Sauer; 1917, Sherman Hall; 1918, no contest.

Intercollegiate Champions: 1916, L. Mouquin; 1917, Jeter (Navy); 1918, Javier Horcasitan (Mexican).

Hockey Records.

Amateur Hockey League Championships: 1913, New York; 1914, Saint Nicholas; 1915, Saint Nicholas; 1916, Saint Nicholas; 1917, Boston; 1918, New York.

World's Professional Hockey Championship (Stanley Cup): 1912, Quebec; 1913, Quebec; 1914, Toronto; 1915, Vancouver; 1916, Les Canadiens; 1917, Metropolitans (Seattle); 1918, Toronto.

Skating Records.

International Outdoor Championship: Late records are: 1914, Three-quarters mile, R. G. McLean in 2 minutes, 14 4–5 seconds; 220 yards, R. G. McLean in 23 4–5 seconds; Half-mile, R. G. McLean in 1 minute, 42 1–5 seconds; One mile, R. G. McLean in 4 minutes, 3 seconds; Two miles, R G. McLean in 9 minutes, 2 seconds; Three miles, H. Cody in 12 minutes, 42 seconds. 1915, 220 yards, Edmund Horton in 20 3–5 seconds; Half-mile, Russell Wheeler in 1 minute, 25 seconds; One mile, H. Cody in 2 minutes, 58 1–5 seconds; Two miles, Russell Wheeler in 6 minutes, 10 seconds; Three miles, Anton O'Sicky in 9 minutes, 42 seconds. 1916, 220 yards, Lot Roe in 21 2–5 seconds; Half-mile, Ray McWhirter in 1 minute, 28 3–5 seconds; One mile, Harry Cody in 3 minutes, 15 2–5 seconds; Two miles, Arthur Staff in 6 minutes, 24 4–5 second; Three miles, Carl Fisher in 9 minutes, 42 4–5 seconds. 1917, 220 yards, E. Horton in 20 1–5 seconds; Half-mile, Arthur Staff in 1 minute, 24 2–5 seconds; One mile, S. Larsen in 2 minutes, 52 seconds; Two miles, Arthur Staff in 5 minutes, 57 3–5 seconds; Three miles, Arthur Staff in 9 minutes, 35 1–5 seconds. Other skating records are in World's Records section.

Bowling Records.

American Bowling Congress: 1916, Individual, Frank Shaw, Chicago, 685; two-man event, Thoma and Marino, Chicago, 1,279; five-man event, Commodore Barry's, Chicago, 2,905. 1917, Individual, Otto Kallusch, Rochester, 698; two-man event, Satorius-Holzschuh, Peoria, 1,346; five-man event, Birk Brothers, Windy City League, 3,061. 1918, Individual, C. Styles, Detroit, 702; two-man event, H. Steers and Fred Thoma, 1,335; five-man event, Aquilas Cigars, Saint Paul, 3,022.

College Athletics.

Intercollegiate Amateur Athletic Association Championship Winners: 1912, Pennsylvania; 1913, Pennsylvania; 1914, Cornell; 1915, Cornell; 1916, Cornell; 1917, no games; 1918, Cornell.

Golf Records.

United States Open Championship Winners: 1912, Jack McDermott; 1913, Francis Ouimet; 1914, W. C. Hagen; 1915, Jerome Travers; 1916, Charles G. (Chick) Evans, Jr.; 1917, no games; 1918, no games.

United States Amateur Championship Winners: 1912, J. Travers; 1913, J. D. Travers; 1914, Francis Ouimet; 1915, Robert A. Gardner; 1916, Charles G. Evans, Jr.; 1917, no games; 1918, no games.

Track and Field Athletics.

National Amateur Athletic Union, Junior Championships: 1912, New York Athletic Club; 1913, Chicago Amateur Athletic; 1914, New York Athletic Club; 1915, Olympic Club; 1916, New York Athletic Club; 1917, Illinois Athletic Club; 1918, Chicago Athletic Association.

National A. A. U. Senior Championships: 1912, Irish-American A. C.; 1913, Irish-American A. C.; 1914, Irish-American A. C.; 1915, Olympic Club; 1916, Irish-American A. C.; 1917, Chicago A. A.; 1918, Chicago A. A.; 1919, New York A. C.

N. A. A. U. All-Round Championships: 1912, James Thorpe (Indian); 1913, F. C. Thompson; 1914, Avery Brundage; 1915, A. Richards; 1916, Avery Brundage; 1917, I. H. Goelitz; 1918, Avery Brundage.

Swimming.— A. A. U. Championships.

Senior National Indoor Swimming Championships: 1916, 50 yards, by Duke P. Kahanamoku; 100 yards, by Perry McGillivray; 200 yards, Michael McDermott; 220 vards, Herbert Vollmer; 500 yards, Ted Cann. 1917, 50 yards, P. McGillivray; 100 yards, Ted Cann; 220 yards, N. Ross; 500 yards, N. Ross.

Senior National Outdoor Championships: 1916, 440 yards, Ludy Langer; 880 yards, Ludy Langer; One mile, Ludy Langer. 1917, 440 yards, N. Ross; 880 yards, W. L. Wallen; One mile N. Ross. 1918, 440 vards, W. L. Wallen; 880 yards, W. L. Wallen; One mile, W. L. Wallen.

Rowing Records.

Yale vs. Harvard — Varsity Eights: 1913, Harvard; 1914, Yale; 1915, Yale; 1916, Harvard; 1917, no race; 1918, Harvard.

Oxford and Cambridge: 1913, Oxford; 1914, Cambridge; war precluded races in 1915, 1916, 1917 and 1918.

For other records see World's Records tables at end of this article.

WORLD'S SPORT RECORDS.

RUNNING AMATEUR RECORDS.

Event	Time	Holder.	Country	Date
100-yards	9 3/5s	D. J. Kelly	U. S. A	1906
150 yards	14 2/5s	W. R. Applegarth	England	1913
200 yards	19 2/5s	W. R. Applegarth	England	1912
250 yards	24 3/5s	W. T. Macpherson	England	1891
300 yards	29 3/4s	J. Donaldson	England	1913
350 yards	36 2/5s	M. W. Long	U. S. A	1900
400 yards	42 1/5s	M. W. Long	U. S. A	1900
440 yards	47s	M. W. Long	U. S. A	1900
500 yards	57 3/5s	C. N. Seedhouse	England	1913
600 yards	1m. 10 4/5s	M. W. Sheppard	U. S. A	1910
880 yards	1m. 51 1/5s	J. E. Meredith	U. S. A	1910
1,000 yards	2m. 12 2/5s	Mel. Sheppard	U. S. A	1915
1,500 yards	3m. 58 1/5s	W. Snook	England	1886
1 mile	4m. 12 3/5s	N. S. Taber	U. S. A	1913
1 mile	4m. 14 2/5s	Joie W. Ray	U. S. A	1919
2,000 yards	5m. 7 1/5s	A. Shrubb	England	1903
1 1/2 miles	6m. 46 2/5s	T. P. Conneff	U. S. A	1895
2 miles	9m 9 3/5s	A. Shrubb	England	1904
3 miles	14m. 17 3/5s	A. Shrubb	England	1903
4 miles	19m. 23 2/5s	A. Shrubb	England	1904
5 miles	24m. 33 2/5s	A. Shrubb	England	1904
6 miles	29m. 59 2/5s	A. Shrubb	England	1904
8 miles	40m. 15 1/6s	A. Shrubb	England	1904
10 miles	50m. 40 3/5s	A. Shrubb	England	1904
15 miles	1h. 23m. 24 1/5s	C. Pores	England	1919
20 miles	1h. 51m. 54s	G. Grossland	England	1894
25 miles	2h. 39m. 29 2/5s	H. Green	England	1913
30 miles	3h. 17m. 36 1/2s	J. A. Squires	England	1885
50 miles	6h. 13m. 58s	E. W. Lloyd	England	1913
100 miles	17h. 36m. 14s	J. Saunders	U. S. A	1882

RUNNING — PROFESSIONAL RECORDS.

Event	Time	Holder	Country	Date
100 yards	9 1/2s (down hill)	A. B. Postle	Australia	1906
100 yards	9 3/5s	R. Walker	South Africa	1913
120 yards	11 1/4s	J. Donaldson	South Africa	1909
130 yards	12s	J. Donaldson	New South Wales	1911
150 yards	14s	J. Donaldson	South Africa	1911
200 yards	19 1/2s	J. Applett	England	1876
300 yards	30s	H. Hutchins	England	1884
350 yards	37 1/5s	B. R. Day	W. Australia	1906
400 yards	44 4/5s	A. R. Downer	England	1897
440 yards	47 4/5s	B. R. Day	W. Australia	1907
500 yards	59s	J. Powers	U. S. A	1881
600 yards	1m. 13s	E. C. Bredin	England	1897
880 yards	1m. 53 1/2s.	Frank Hewitt	England	1871
3/4 mile	3m. 7s	Wm. Richards	England	1866
1 mile	4m. 12 3/4s	W. G. George	England	1886
1 1/2 miles	6m. 43 1/2s	W. Cummings	England	1880
2 miles	9m. 11 1/2s	W. Lang	England	1883
3 miles	14m. 19 1/2s	P. Cannon	England	1888
4 miles	19m. 25 2/5s	P. Cannon	England	1888
5 miles	24m. 40s	J. White	England	1863
10 miles	51m. 5 1/5s	H. Watkins	England	1899
50 miles	5h. 55m. 4 1/2s	G. Cartwright	England	1887
100 miles	13h. 26m. 30s	C. Rowell	U. S. A	1882
500 miles	109h. 18m. 20s	P. Fitzgerald	U. S. A	1884

AMATEUR WALKING RECORDS.

Event	Time	Holder	Country	Date
Quarter mile	1m. 22 1/5s	F. H. Creamer	New Zealand	1897
Half mile	3m.	F. H. Creamer	New Zealand	1897
1 mile	6m. 22 4/5s	W. Murray	Australia	1912
2 miles	13m. 11 2/5s	G. E. Larner	England	1904
3 miles	20m. 25 4/5s	G. E. Larner	England	1905
4 miles	27m. 14s	G. E. Larner	England	1905
5 miles	36m. 1/5s	G. E. Larner	England	1905
6 miles	43m. 26 1/5s	G. E. Larner	England	1905
7 miles	50m. 40 2/5s	G. H. Goulding	U. S. A	1915
8 miles	58m. 8 2/5s	G. E. Larner	England	1905
10 miles	1h. 15m. 57 2/5s	G. E. Larner	England	1908
15 miles	2h. 7m. 17 3/5s	Ed. Renz	U. S. A	1917
20 miles	2h. 47m. 52s	T. Griffith	England	1870
25 miles	3h. 37m. 6 4/5s	S. C. A. Schofield	England	1911
50 miles	7h. 52m. 27s	J. Butler	England	1905
100 miles	18h. 4m. 10 1/5s	T. E. Hammond	England	1908
1 hour	8 miles, 438 yards	G. E. Larner	England	1905
2 hours	15 miles, 128 yards	H. V. L. Ross	England	1911
12 hours	73 miles, 14 yards (road walk)	E. C. Horton	England	1914
24 hours	131 miles, 580 3/4 yards	T. E. Hammond	England	1908

PROFESSIONAL WALKING RECORDS.

Event	Time	Holder	Country	Date
1 mile	6m. 23s	W. Perkins	England	1874
2 miles	13m. 14s	J. W. Raby	England	1883
3 miles	20m. 21 1/2s	J. W. Raby	England	1883
4 miles	27m. 38s	J. W. Raby	England	1883
5 miles	35m. 10s	J. W. Raby	England	1883
8 miles	58m. 37s	J. Meagher	U. S. A	1882
15 miles	1h. 55m. 56s	J. W. Raby	England	1883
20 miles	2h. 39m. 57s	W. Perkins	England	1877
30 miles	4h. 34m. 54s	W. Howes	England	1878
40 miles	6h. 16m. 50s	W. Howes	England	1878
50 miles	7h. 54m. 16s	J. Hibberd	England	1888
100 miles	18h. 8m. 15s	W. Howes	England	1880
500 miles	130h. 33m. 45s	G. Littlewood	England	1882
Six days	531miles, 135 yards	G. Littlewood	England	1889

World's Sport Records — Continued

JUMPING, AMATEUR.

Event	Record	Holder	Country	Date
Running nigh jump	6ft. 7 5/16in	E. Beeson	U. S. A	1914
Running broad jump	24ft. 11 3/4in	P. O'Connor	Ireland	1901
Standing broad jump	11ft. 6in	R. C. Ewry	U. S. A	1906
Standing high jump	5ft. 5 3/4in	L. Goehring	U. S. A	1913
Three standing jumps	35ft. 8 3/4in	R. C. Ewry	U. S. A	1903
Pole jump	13ft. 2 1/4in	M. S. Wright	U. S. A	1912
Hop, step and jump	50ft. 11in	D. Ahearn	U. S. A	1911

JUMPING, PROFESSIONAL.

Event	Record	Holder	Country	Date
Running high jump	6ft. 1/2in	E. W. Johnson	U. S. A	1881
Running wide jump	22ft. 6in	T. F. Keane	England	1900
Standing broad jump	12ft. 1 1/2in	J. Darby	England	1890
Standing high jump	5ft. 5 1/2in	J. Darby	England	1892
Three standing jumps	36ft. 3in	T. Colquitt	England	1907
Pole jump	11ft. 9in	R. B. Dickerson	Ireland	1892
Hop, step and jump	48ft. 8in	T. Burrows	U. S. A	1884

HURDLE JUMPING, AMATEUR.

Event	Record	Holder	Country	Date
120 yards	15s. (10 hurdles 3ft. 6in. high)	F. C. Smithson	U. S. A	1908
220 yards	23 3/5s.(10 hurdles 2ft. 6in. high	A. Kraenzlein	U. S. A	1898
440 yards	56 4/5s. (10 hurdles 3ft. high)	G. R. Anderson	England	1910

THROWING WEIGHTS, AMATEUR.

Event	Record	Holder	Country	Date
Putting 16-lb. weight	51ft	R. Rose	U. S. A	1909
Throwing 16-lb. hammer	191ft. 5in	P. McDonald	U. S. A	1912
Throwing 56-lb. weight	40ft. 6 3-8in	M. J. McGrath	U. S. A	1911
Throwing discus	143ft. 9 1/2in. (4 2/5 lb.)	J. Duncan	U. S. A	1912
Throwing javelin	207ft. 7in	F. Mayyrae	Sweden	1914

SWIMMING, AMATEUR.

Event	Record	Holder	Country	Date
50 yards	23 2/5s	Duke P. Kahanamoku	Hawaii	
100 yards	53s	D. P. Kahanamoku	Hawaii	
120 yards	1m. 8 2/5s. (bath)	P. McGillivray	U. S. A	
150 yards	1m. 29 4/5s. (bath)	H. C. Vollmer	U. S. A	
200 yards	2m. 7 2/5s	H. J. Hebner	U. S. A	
300 yards	3m. 16 3/5s. (bath)	Norman Ross	U. S. A	
400 yards	4m. 51 1/5s	B. Kieran	Australia	
440 yards	5m. 17s	Ludy Langer	Hawaii	
500 yards	5m. 53 2/5s. (bath)	Norman Ross	U. S. A	
600 yards	7m. 32 2/5s	B. Kieran	Australia	
800 yards	10m. 11 3/5s	B. Kieran	Australia	
1,000 yards	12m. 52 2/5s	B. Kieran	Australia	
1,500 yards	19m. 47 4/5s	B. Kieran	Australia	
1 mile	23m. 16 4/5s	B. Kieran	Australia	
2 miles	54m. 54s	George Read	Australia	

WORLD TROTTING RECORDS.

Distance	Horse	Time	Date
1 mile	Uhlan	1:58	1912
1 mile	Uhlan (with running mate)	1:54½	1913
1 mile	Major Delmar (high wheel sulky)	2:07	1904
2 miles	Harvester	4:15¼	1910
4 miles	Bertie R. (in England)	9:58	1899
10 miles	Pascal	26:15	1893
50 miles	Ariel	3:55:40½	1846
100 miles	Conqueror	8:55:53	1853

WORLD PACING RECORDS.

Distance	Horse	Time	Date
1 mile	Dan Patch	1:55¼	1906
2 miles	Dan Patch	4:17	1903
5 miles	Marconi (in Quebec)	12:03¼	1917

AUTOMOBILE RECORDS.

Event	Car	Driver	Place	Time	Date
1 mile	Blitzen-Benz	Burman	Daytona	25.50	1911
2 miles	Blitzen-Benz	Burman	Daytona	51.28	1911
3 miles	Packard Special	Rader	Sheepshead Bay	1:26.61	1917
5 miles	Packard Special	Rader	Sheepshead Bay	2:24.65	1917
10 miles	Packard Special	Rader	Sheepshead Bay	4:50.88	1917
20 miles	Packard	De Palma	Chicago	10:50.20	1918
25 miles	Packard	De Palma	Chicago	14:12.72	1917
50 miles	Packard	De Palma	Sheepshead Bay	26:23.1-5	1919
100 miles	Frontenac	Chevrolet	Brooklyn, N. Y	54:20.98	1917
150 miles	Hudson Special	Mulford	Chicago	1:26:14.90	1917
200 miles	Hudson Special	Mulford	Chicago	1:55:11.05	1917
250 miles	Peugeot	Aitken	Sheepshead Bay	2:23:04.03	1916
300 miles	Stutz	Anderson	Sheepshead Bay	2:55:32.23	1915
500 miles	Peugeot	Resta	Chicago	5:07:26.00	1915

TRAP SHOOTING RECORDS, PROFESSIONAL AND AMATEUR.

Straight scores: 565 straight by C. G. Spencer, 16 yards, Viola, 1909; 419 by J. R. Graham, 16 yards, Chicago, 1910; 99 by E. C. Carlton, 17 yards, Omaha, 1913; 104 by Harvey Dixon, 18 yards, Saint Louis, 1916; 100 by Riley Thompson, 19 yards, Chicago, 1910; 100 by C. A. Gunning, 19 yards, Omaha, 1913; 138 by H. S. Wells, 20 yards, Betterton, Md., 1915; 119 by Fred Plum, 21 yards, Mapleton, N. H., 1916; 108 by Mark Arie, 22 yards, Chicago, 1917; 99 by Walter Huff, 22 yards, Atlanta, 1917; 100 by C. A. Young, 23 yards, Peru, Ind., 1916.

BILLIARD RECORDS.

Straight-rail: Maurice Vignaux, 1,531 on 5×10 table, Paris, 1890; Jacob Schaefer, 3,000 run on 4½×9 table, San Francisco, 1890. 14.2 balkline and anchor allowed, Jacob Schaefer, 566; same, anchor barred, F. C. Ives, 359. 18.1 balkline, 359, F. C. Ives, 1897. 18.2 balkline, W. F. Hoppe, 308, 1915. 14.1 balkline, W. F. Hoppe, 303, 1914. Cushion-caroms, F. C. Ives, 85, 1896; three-cushion, G. W. Moore, 15, 1911. Continuous pocket billiards, B. Allen, 71, 1914.

RAILROAD SPEEDS.

Records are: Philadelphia and Reading, 1904, 4.8 miles in 2m,. 30s., from Egg Harbor to Brigantine Junction, averaging 115.20 miles per hour. New York Central and Hudson River Railroad, by "Empire State Express," in 1893, 1 mile in 32 seconds, averaging 112.5 miles per hour. Fleming to Jacksonville, 5 miles, in 2m., 30s., an average of 120 miles per hour (1901). Long distance recores are: Paddington to Bristol, England, on Great Western Railway, in 1904, 118.5 miles in 1h., 24m., averaging 84.6 miles per hour. Alpine, N. Y., to Geneva Junction, N. Y., on Lehigh Valley Railroad "Black Diamond Express," 43.96 miles in 33 minutes, averaging 80 miles per hour.

BICYCLING.

Records: Fastest amateur mile in competition' 1m., 53 2/5s., by Hans Ohrt, 1915. 100 kilometer paced record is 59m., 1s. by Guignard, 1909. One-hour professional paced record is 63 miles 189.8 yards by Guignard, 1909. Amateur one-hour paced record is 56 miles 1,128 yards by F. Cuzin, 1909. One-hour unpaced record is 27.50 by Oscar Egg, 1914.

MOTORCYCLE RECORDS.

Professional: One mile in 36s.; two miles in 1m., 12 2/5s.; five miles in 3m., 6 4/5s.; 10 miles in 6m., 6 1/8s.; 25 miles in 16m., 27s.; all by Ray Seymour, 1912. 50 miles in 33m., 55 1/5s. by W. Humiston; 100 miles by Humiston; 200 miles in 4h., 5m., 54 2/5s., by H. Martin, 1909; 400 miles in 9h., 6m., 25 4/5s., by H. A. Collier, 1909. In 6 hours 294 miles 800 yards; 12 hours, 471 miles 784 yards. In continuous riding, A. T. Bedell did 1,153½ miles in 24 hours, 1917.

Amateur one-mile in 55 4/5s., by C. Spencer, 1909, with standing start; Lon Claflin, 1912, did one mile in 38 4/5s., five miles in 3m. 18 4/5s., 10 miles in 6m., 42s. Fred Huyck did (1909) 25 miles in 20m. 54s. 100 miles was done by M. J. Graves, 1915, in 1h., 34m., 41s. 500 miles in 10h. 22m, 36s., by C. Spencer, 1909, who did 1,000 miles in 22h, 20m. 59s., same date.

MOTOR BOAT RACING RECORDS

1913. Philadelphia to Bermuda (734 miles) won by *Dream* in 87h., 25m. Bermuda to Brooklyn (680 miles) by *Tocsam II* in 70h., 27m., 39s., New York to Albany (235 miles) by *Blue Peter V* in 23h., 2m., 45s. International Harmsworth Trophy won at Isle of Wight by *Mapleleaf* at average speed 55.646 miles per hour. (No races till after the War.)

1916. The Lake George Cup Race winner, *Miss Minneapolis*, averaged in six one mile trials a speed of 61.08 statute miles per hour.

1917. New York City to Albany and return, 235 miles in 29h., 38m., 26s., by *Luella*. Miami to Palm Beach, Fla., 70 miles, in 1h., 47m., by *Raven III*. In the National One-Mile championship race, *Miss Detroit II* won. She did six one-mile dashes against time, averaging 61.72 miles per hour.

SKATING.

American amateur records: 50 yards, Robert McLean in 5s. (1914). 100 yards, Morris Wood in 9 3/5s. (1903). One mile, Morris Wood in 2m., 41 1/5s. (1904). One and one-half miles, L. Roe in 4m., 10s. (1910). Four miles, A. Schiebe in 12m., ½s. (1894). Five miles, E. Lamy in 14m., 55s. (1910). 1,000 metres, J. K. McCulloch in 1m., 47s. (1897). 1,500 metres, J. K. McCulloch in 2m., 40 4/5s. (1897). 5,000 metres, J. K. McCulloch in 9m., 25 2/5s. (1897).

World's amateur records: 500 metres in 43 7/10s.; 1,000 metres in 1m., 31 2/5s.; 1,500 metres in 2m., 19 1/2s.; 5,000 metres in 8m., 36 3/5s. 10,000 metres in 17m., 22 6/10s. All by O. Mathiesen of Norway.

Professional records: 50 yards, S. D. See and C. B. Davidson in 6s. (1885). 100 yards, J. S. Johnson in 9 4/5s. (1893). 440 yards, J. S. Johnson in 31 3/4s. (1896). 600 yards, O. Rudd in 55 3/5s. (1893). One mile, Arthur Staff in 2m., 35s. (1916). One and one-half miles, J. Johnson in 4m., 28s. (1894). Two miles, J. Nillson in 5m., 33 2/5s. (1900). Three miles, J. Nillson in 8m., 41 1/5s. (1900). Four miles, J. Nillson in 12m. 1/5s. (1897). Five miles, O. Rudd in 14m. 34s. (1896). 20 miles, A. D. Smith in 1h., 6m., 36 2/5s. (1894). 25 miles, John Karlsen in 1h., 30m., 15s. (1916). 50 miles, J. F. Donohue in 3h., 15m., 59 2/5s. (1893). 100 miles, J. F. Donohue in 7h., 38 1/5s. (1893).

BOWLING.

World's records: Individual, open, three games, Roy Flagg, 270, 300, 300, average 290, 1906. Six games, Lee R. Johns, average 271½, 1909. All events, Mortimer Lindsey, in nine games, average 225 6/9, 1912. Highest woman's score, Mrs. Nellie Lester, New York, 277, 1909. Two-men, open, Knox-Satterthwaite, Philadelphia, 1,445, 1912. Six games, Charles Schaeder, average 256 1/6, 1907.

SPORTS IN PLANTS, a term in biology denoting an individual which differs more or less markedly from the type or parent species; an aberrant form. It is distinguished from "monstrosity" by its ability to transmit its aberrant character either sexually or asexually to offspring; whereas monstrosities properly so-called lack this power, their offspring, if any, reverting to the general type. The origin of sports has furnished much food for speculation, some biologists assuming that aberrations are freaks which nature destroys, while others declare that the transmutation of species is dependent upon them through the processes of natural selection of the adaptive ones. If the term is to be used as an approximate synonym of monstrosity the first hypothesis is probably true; but if used in its broadest sense the latter is more nearly correct. The matter hinges mainly upon the extent of observation; for, while sports among undomesticated animals are comparatively rare, they are numerous among uncultivated plants, but have been commonly overlooked because biologists have been more awake to the animal than the plant. Each leaf-bud of a plant is capable of producing leaves and branches which differ from those produced by any other bud, and every flower-bud may produce a flower unlike any of its fellows; nay, further, the individual seeds which follow any flower in a single fruit may produce plants unlike one another in many respects and also unlike the parent. But unless these departures are striking enough to attract the attention of the ordinary observer as distinct they are unnoted and hence not calculated upon; hence the popular opinion that sports appear "suddenly," since only the remarkable cases are observed.

They can be no doubt that sports result from unusual or complex stimuli or unaccountable refrangibility of vegetative force, and for these reasons may be, usually are, unstable when normal conditions are again operative. However, this does not oppose but it rather enforces the statement that sports result from the same causes as underlie all variation in the plant kingdom, bud-variation being one of the most important and significant phenomena of plantlife. But though the causes are usually unknown in plants and vertebrate animals, sports have been produced artificially with diverse lepidopterous insects by varying the humidity, dryness and temperature of the air during the process of growth or pupation. The crossing of the sports with the type-species does not usually result in an intermediate form but in two main groups, in one of which the offspring resemble the male parent and in the other the female.

From a practical standpoint, selection and breeding of sports has long been widely employed. Among domestic animals one of the most striking instances is that of Ancon or otter sheep, the ancestor of which was a long-bodied, crooked-legged freak which was bred to sheep of normal character. Only the individuals which resembled the aberrant parent were used for subsequent breeding. With domesticated plants the practice of breeding from the sports is still more striking, because it can be practised either sexually or asexually. The initial sport may appear as a seedling or as a "bud-variation." In the former case the gardener usually progagates by means of seed, rigorously discarding all specimens that depart unfavorably from the apparent intent of the primal sport, and carefully saving those specimens that approximate or accentuate the characters. If the sport is a bud-variation the gardener usually propagates it by means of cuttings, practising a careful suppression of individuals which seem to retrogress and selecting desirable ones for further propagation, as in the former case. It may seem expedient to practise asexual methods with a plant produced sexually or vice-versa; in each case, however, the after-selection is imperative. Some bud-varieties fail to «come true» even from cuttings, and failure in this respect is common among seed sports. Bud-variation and seed-variation are the same kind since the same means of improvement can be used in each case.

Far from being comparatively rare, sports are very common among cultivated plants, almost every species of importance furnishing instances. Among well-known bud-sports: the purple or copper beech, purple-leaved plums, and many weeping, variegated and cut-leaved trees and shrubs, are familiar examples. The *perle des jardins* rose has given rise to several commercially important bud-varieties. The moss-roses are bud-sports. The «mixing» of potatoes in the hill is also well known. Among plants propagated by seeds instances are legion — tomatoes, cabbage, corn, parsley, onions and a host of garden flowers. Probably the most striking instance of a plant producing both bud-sports and seed-sports of value is the peach. Occasionally a seed will produce a smooth-skinned fruit popularly called a nectarine, which in turn may produce either a nectarine or a peach. Certain branches of the peach tree may produce nectarines and vice-versa. Russet apples are sometimes seen upon greening trees. The sports may occur in any part of the parent plant — roots, tubers, rhizomes, stems, flowers, leaves, seeds and even buds upon the stem or the roots.

Another practical application of the tendency to sport among plants is the grafting of fruit trees with scions taken from the «bearing wood» of specially prolific or precocious trees of any particular variety. Such scions usually commence to bear earlier, or produce more regularly, or both, than scions taken from shaded portions of the same parent trees or from unproductive individuals.

One of the common troubles with sports is self-sterility. This is scarcely important except with fruit trees where, if large blocks of one kind of tree are planted remote from other varieties that blossom at the same time, little or no fruit will be set. See paragraph *Varieties* under title APPLE.

Sports are to be distinguished from reversions in which the individual seems to hark back to the general form of its more or less distant ancestors. They must also be separated from cases of atavism (q.v.) in which the progeny exhibit a character not typical of their race, species or genus but characteristic of an allied ancestral race. Instances of reversion (q.v.) are the loss of the bulbous root of turnips and the «head» of cabbage which «run Wild»; of atavism, the occasional appearance of several-toed horses, whose feet somewhat resemble the three-toed foot of the horse of Tertiary time. See BREEDING; BUD; HEREDITY; HYBRIDITY; NATURAL SELECTION; VARIATION, and consult the authorities cited under them.

SPOT, a fish. See GOODY.

SPOTSWOOD, spŏts'wŭd, **Alexander**, American colonial governor: b. Tangier, Africa, 1676; d. Annapolis, Md., 7 June 1740. He entered the English army in early youth, fought at the battle of Blenheim, was deputy quartermaster-general under the Duke of Marlborough and in 1710 was appointed governor of Virginia. His administration was one of great benefit to the colony, he was the bearer of the writ of habeas corpus, a fact which gained for him the favorable attention of the colony, and his popularity was for a long time unbroken. He greatly assisted the William and Mary College, concluded a treaty with the Six Nations in 1722 which secured for the colonists the territory east of the Blue Ridge, south of the Potomac, and originated the act to make tobacco notes a medium of purchase, introduced various beneficial measures into the colony. His aim was invariably the good of the colony, but his haughtiness won for him in time enemies, and the controversy which arose over church patronage, which he held to be a privilege of his office, enabled his opponents to gain his removal from office in 1722. He continued his residence in Virginia, served as deputy postmaster-general in 1730–39 and greatly improved mail facilities. He fostered the iron industry, endeavored to promote vine-culture and otherwise evinced an undiminished interest in the colony. In 1740 he was appointed major-general to command an expedition to the West Indies, but died just previous to embarking. His letters were purchased by the Virginia Historical Society in 1882 and published in their collection as 'The Official Letters of Alexander Spotswood, Lieutenant-Governor of Virginia in 1710–1722' (1882–85).

SPOTSWOOD, or SPOTISWOOD, spŏt'ĭs-wŭd, **John**, Scottish ecclesiastic: b. in the parish of Mid-Calder, Midlothian, 1565; d. London, 26 Nov. 1639. He studied at the University of Glasgow, and at 18 became assistant to his father as parson of Calder. At the outset he supported the Presbyterian party, but in 1601, when the Earl of Lennox was sent as Ambassador to France, Spotswood accompanied him as chaplain and «made no scruple to go in to mass.» On his return he was complained of to the General Assembly, but through the influence of the court escaped with merely a reprimand. He became a favorite at court, and in 1603, when King James set out for England, was one of the five Scottish clergymen selected to accompany him. In the course of the journey news arrived of the death of the archbishop of Glasgow, and Spotswood was immediately appointed his successor, and in consequence returned to Scotland, but was not consecrated till 1610. In 1615 he exchanged Glasgow for the metropolitan see of Saint Andrews and became primate of Scotland. In 1618 he presided over the General Assembly at Perth, and succeeded in carrying the five points of ecclesiastical discipline known as the Perth Articles. He continued to enjoy royal favor under Charles I, whom he crowned in the abbey church of Holyrood in 1633, and a little later he was made chancellor of Scotland. But by his harsh procedure against Lord Balmerino contributed greatly to inflame the opposition to episcopal government, which now became general among all ranks, and finally led to its overthrow. In

1638, at the assembly held at Glasgow, he was deposed, excommunicated and declared infamous. He saved himself by flight, and took up his residence in London, where he died. He is the author of a 'History of the Church of Scotland' (1655), commencing at 203 and continued to the end of the reign of James VI.

SPOTTED FEVER, cerebro-spinal meningitis. (See MENINGITIS). Spotted fever is a term also applied to a form of typhus fever (q.v.).

SPOTTED SANDPIPER. See SANDPIPER.

SPOTTISWOODE, spŏt'ĭs-wŭd, **William**, English mathematician and physicist: b. London, 11 Jan. 1825; d. 27 June 1883. He was educated at Balliol College, Oxford, and in 1846 became manager of his father's printing establishment, the well-known house of Eyre and Spottiswoode. He was the author of 'A Tarantasse Journey through Eastern Russia' (1857); 'Meditationes Analyticæ' (1847); 'Elementary Theorems relating to Determinants' (1851); 'The Polarization of Light' (1874), etc. He was president of the London Mathematical Society (1870-72), of the British Association (1878), and of the Royal Society (1878). In mathematics he is chiefly distinguished as one of the first to make extensive use of the symmetrical determinant notation, and as the author of a series of papers in the 'Philosophical Transactions' of 1862 and the following years on the contact of curves and surfaces. In physics he devoted himself mainly to the study of polarized light and electrical discharge through rarefied gases.

SPOTTSYLVANIA COURT HOUSE, Battles of. The battle of the Wilderness (q.v.) was fought 5 and 6 May 1864, and a reconnoissance made by General Birney's division down the Orange plank road, on the morning of the 7th, developed the fact that the Confederates had fallen back to their intrenched lines, with pickets to the front, covering a part of the battlefield. "From this," says General Grant, "it was evident to my mind that the two days' fighting had satisfied him (Lee) of his inability to further maintain the contest in the open field, notwithstanding his advantage of position, and that he would await an attack behind his works. I, therefore, determined to push on and put my whole force between him and Richmond, and orders were at once issued for a movement by his right flank." The first objective was Spottsylvania Court House, 15 miles southeast of the Wilderness field, which, by a night march it was proposed to reach early on the morning of the 8th. As a preliminary to the movement Sheridan's cavalry was to seize Todd's Tavern, on the Brock road, midway between the Wilderness field and Spottsylvania Court House, and hold the place and the roads crossing Po River. This was done on the 7th, the Confederate cavalry being driven from the place, Wade Hampton's division retreating south to Corbin's bridge over the Po, and Fitzhugh Lee's eastward on the Brock road toward the Court House. (See TODD'S TAVERN, ENGAGEMENT AT). At 3 P.M. the trains began their movement toward Chancellorsville and Piney Grove Church; Warren's Fifth corps started after dark and, marching on the Brock road, along the rear of Hancock's Second corps, arrived at Todd's Tavern at 3 A.M. of the 8th, much impeded and delayed in its march by the mounted provost guard of the army which immediately preceded it; Sedgwick's Sixth corps followed, marching eastward to Chancellorsville, then southward to connect with Warren; and Burnside's Ninth corps followed Sedgwick. Hancock's Second corps did not march until daylight when it moved to the left on the Brock road to Todd's Tavern, which it reached at 9 A.M. of the 8th, and intrenched. When Warren arrived at Todd's Tavern he found Merritt's cavalry division engaged with that of Fitzhugh Lee. At 6 A.M. Merritt was withdrawn and Robinson's division of Warren's corps took its place and, slowly driving back Lee's cavalry, had reached open ground one and one-half miles from the Court House, when from a piece of wood 200 to 300 yards in front it received a heavy musketry and artillery fire, which severely wounded Robinson, and so staggered his division that it fell back to the woods in its rear. Robinson had encountered two brigades of R. H. Anderson's corps, the advance of Lee's army, which had beaten Grant in the race for Spottsylvania Court House. Lee had divined Grant's intention and, on the 7th, had cut a military road through the forest from the Orange plank road to the highway by Shady Grove Church, thence eastward to the Court House; and being informed by Stuart, late in the day, that Grant's trains were in motion southward, that night he gave orders for the movement of his army to the Court House, on roads nearly parallel to the Union line of march, and but a mile from the Brock road. Gen. R. H. Anderson, who commanded Longstreet's corps, had been ordered to move on the morning of the 8th, but being much troubled by the fire and suffocating smoke in the Wilderness woods, concluded to avoid it, set out at 11 P.M. of the 7th and, marching all night, arrived near the Court House at 8 o'clock next morning. There, finding Lee's cavalry engaged with Warren's infantry, he marched part of his corps to Lee's support, and two brigades marched on to the Court House and occupied it, Wilson's cavalry division, that had been sent by Sheridan to seize it, and that had been in possession two hours, withdrawing. Lee's cavalry withdrew as Anderson came up, and Anderson took up the fight with Warren. Griffin's division of Warren's corps, which had advanced on Robinson's right, was repulsed, and both fell back upon Crawford's and Cutler's divisions, which had now reached the front. Cutler advanced and drove the Confederates from Griffin's right, and Warren threw up intrenchments from 200 to 400 yards from those of the enemy. It was now about noon. About 1 P.M. Sedgwick came up, under Meade's order to support Warren in an assault upon the Confederate position, the right of which rested on the Brock road. It was late in the day when the assault was made. Penrose's New Jersey brigade of the Sixth corps charging over open ground was repulsed by the right of Anderson's corps. A little later Crawford's division of Warren's corps went forward, passed the right of Anderson and struck Rodes' division of Ewell's corps, which was going into position on Anderson's right. Rodes, taken at a disadvantage, was driven back some distance, but rallied and drove Crawford back to his intrenchments. Ewell's entire corps came up during the evening and formed on Anderson's right. The Union loss during the day was about 1,300.

A. P. Hill's corps, under command of General Early, came up on the morning of the 9th, and Lee established his lines covering Spottsylvania Court House, with Anderson's corps on the left, resting on Po River, Ewell's corps in the centre and Hill's on the right, covering the Fredericksburg road. The line was 8 to 10 miles long, and the greater part of it ran through woods tangled with undergrowth, or on the edge of them, with slashings and abatis in front. It was everywhere strongly intrenched and well planted with artillery. During the 9th Lee was employed in rectifying and strengthening this line, and Grant in examining and developing it, and also in readjusting his own lines. Skirmishing was sharp on both sides, and early in the morning General Sedgwick, commanding the Sixth corps, was killed. General Wright succeeded to the command of the corps. Early in the day Burnside moved across from the Plank road to the Fredericksburg road, at the crossing of Ny River, east of the Court House, and threw one of his divisions across the river, which encountered infantry and some dismounted cavalry. Hancock moved east from Todd's Tavern to the right of Warren and intrenched, overlooking Po River. Sheridan cut loose from the army and started from Todd's Tavern on his Richmond raid. Burnside had reported to Grant that in his movement on the 9th he had met the enemy east of the Court House and judged from indications in his front that Lee was meditating a movement north toward Fredericksburg, upon which Grant ordered Hancock to make a movement on the 10th on Lee's left, across the east and west bends of Po River. This movement led to the engagement on Po River (q.v.). While this battle was in progress Warren was engaged in feeling the Confederate lines in his front preparatory to an assault and Gibbon's division was withdrawn from Hancock and placed on Warren's right and for the time under his orders. At 11 A.M. Gibbon advanced with two brigades, met an obstinate resistance from Fields' division and was compelled to fall back with much loss. Warren followed with two of his own divisions, with a view to gain ground for the formation of a column of assault, and was repulsed by Fields, but he had gained information of Fields' position which induced him to report to Meade that a general assault would be successful. Hancock had been designated to make the assault at 5 P.M. with the Fifth and Sixth corps and part of his own, but he was engaged at Po River, and at 3.45 P.M. Meade directed Warren to make the assault, which was done with Crawford's and Cutler's divisions of the Fifth corps and Webb's and Carroll's brigades of the Second. The assault fell upon Fields' division and failed, Warren being repulsed with heavy loss, including General Rice killed. General Hancock returned from Po River at 5.30 P.M., just before the close of Warren's assault, and at 7 P.M. made another assault with Birney's and Gibbon's divisions. This assault fell on Geo. T. Anderson's brigade and Greggs' Texas brigade, both of Fields' division. Some of the assaulting troops gained the works held by the Texas brigade and went over them, pushing back the Texans; but a flank fire of Anderson's brigade drove them out and the attack was repulsed, many dead and wounded being left inside the works. The assaulting column fell back in some disorder, the men demoralized by the fruitless work.

At about the same hour General Wright, on the left of Warren, made an assault. He had found what he deemed to be a vulnerable place to a vigorous attack. It was on the west face of the noted salient, held by Rodes' division of Ewell's corps. Upton's brigade of the Sixth corps, reinforced by four regiments of Neills, was to make the assault, supported on the left by Mott's division of the Second corps, which was to assault on its own front at 5 P.M. Upton formed in four lines, and the batteries opened a direct and enfilading fire, which ceased only when Upton charged from the woods, and under a terrible front and flank fire, went over the Confederate works, broke Doles' brigade and part of Daniel's, captured many prisoners, and pushed on to a second line of works upon which he planted his colors, and captured a four-gun battery. He had broken the Confederate line to the length of a division; but Mott had failed in his allotted task of supporting him on the left; and recovering from their surprise and temporary disaster, the Confederates threw two brigades in his front; Daniels, R. D. Johnston's, J. A. Walker's and Steuart's brigades fell upon both flanks; and Upton was ordered to withdraw, which he did under cover of the darkness. He had lost about 1,000 men, many of whom were left dead and wounded inside the Confederate works. He was obliged to abandon the captured battery, but he carried back with him 1,200 prisoners and several stands of colors. Farther to the left Burnside made a reconnoissance toward Spottsylvania Court House, and had a spirited engagement, driving back the enemy close to the Fredericksburg road and intrenching a part of his line, as he reports, within a quarter of a mile of the Court House. In this engagement General Stevenson, one of his division commanders, was killed. During the day of the 10th the Union forces engaged numbered about 38,000; the losses were about 4,200 killed and wounded; but few were missing. The estimated Confederate loss was 2,000 killed and wounded.

On the morning of the 11th Grant reported to Halleck that in the six days' fighting since crossing the Rapidan he had lost 11 general officers and probably 20,000 men; renewed his call for reinforcements, which he hoped would be sent as soon as possible and in great numbers; and assured Halleck that he meant to fight it out on that line if it took all summer. Finding that the Confederate left was so well guarded, he made arrangements to attack the centre at a salient of the line. General Wright was directed to extend his left, concentrate on that wing and he prepared to co-operate with Hancock in an assault. Hancock, with the Second corps, was to pass to the left of Wright during the night and assault the salient at daylight. Warren's Fifth corps was to assault the works in his front to keep the Confederates in them, and on the extreme left Burnside was to lead the Ninth corps in an assault. The day was very stormy and disagreeable, and no serious fighting took place, though there was heavy skirmishing along the entire line, in which the artillery occasionally took part. Wright extended his lines during the afternoon. The two divisions of Barlow and Birney of Hancock's corps started at 10 P.M., and at midnight reached the Brown House, where they found Mott's division; and passing over the intrenchments, and as near to the picket line of the enemy as possible, they began the formation of the column of assault. Barlow's division was formed across a clearing in two lines of masses, each regiment being doubled on the centre. Brooke's and Miles' brigades constituted the first line, and Smyth and Brown the second. Birney's division formed on Barlow's right, in two deployed lines. Mott formed in rear of Birney, and Gibbon's division was placed in reserve. It was nearly daylight when these preparations were completed, and the column formed within 1,200 yards of the Confederate line.

The Battle of the Salient.— The point to be assailed was where Lee's intrenchments had been carried northward to enclose a space about a mile in length and half a mile in width, of the general shape of an acorn: the Confederates called it the "Mule-Shoe." Taken together, the faces of the salient or "Mule-Shoe" covered about two and one-quarter miles in length, and were occupied mainly by Ewell's corps, Edward Johnson's division holding the apex or east angle of the works, and Rodes' division the west angle and face. To provide against contingencies, a second line had been laid off and partly constructed some distance in rear, so as to cut off the salient at its base. In rear of this line was Gordon's division as a reserve. On Ewell's right was A. P. Hill's corps; on his left was Longstreet's, commanded by R. H. Anderson. General Lee had detected some movements that indicated a withdrawal from the front of Anderson's corps and, under the impression that Grant had begun another flanking movement, late in the day he ordered the withdrawal of all the artillery in the left and centre, which was difficult of access, that it should be done before it was entirely dark and that everything should be in readiness to move at any moment. Under this order Ewell's chief of artillery removed all but two batteries from the line of Edward Johnson's division. During the night Johnson discovered that the Union troops were massing in his front; and, convinced that he would be attacked in the morning, he asked Ewell for the immediate return of the artillery. The men in the trenches were on the alert, when at dawn on the morning of the 12th they saw a dense column emerge from the woods half a mile in front of the salient and rush to the attack. Johnson says: "They came on in great disorder, with a narrow front, extending back as far as I could see." The charging column was Barlow's division, led by the brigades of Brooke and Miles. It had been ordered to make the assault at 4 o'clock, but owing to a heavy fog it was not sufficiently light to enable objects to be clearly discerned until 4.30, when the order to charge was given. Birney, on the right, met difficulty in the rough ground over which he moved, but kept nearly abreast of Barlow's line. When the Confederate works were seen a wild cheer was given; Brooke and Miles tore down the abatis, and in the face of a deadly fire sprang over the intrenchments, and a desperate hand-to-hand encounter ensued; Birney came up on the right; the battalion of Confederate artillery that had been withdrawn came back just in time to have its horses and cannoneers shot down before a gun could be fired; and in a very short time nearly a mile of the works had been carried. General Johnson himself and General Steuart, 20 guns, 30 colors and nearly 3,000 men were captured. With scarcely a halt Barlow and Birney swept on for nearly half a mile; then, thoroughly disorganized, they were brought to a stand before another line of works, held by Gen. J. B. Gordon's division and Lane's brigade of Hill's corps. As Gordon was about to charge, General Lee rode up and joined him, evidently intending to go forward with him. Gordon remonstrated, the men cried, "General Lee to the rear!" and one of them seized the general's bridle and led his horse to the rear, and Gordon's men went forward and attacked the Union lines in rear of the captured works. After a fierce struggle in the pine woods the Union troops, piled in one upon another, six or eight lines deep, were forced back out of the works but held the outer side of them. The Sixth corps, coming up, took post on the right of the Second, occupying the line from the west angle southward; Mott's division joined the Sixth corps at that angle; Birney's division came next on the left; then Gibbon's; then Barlow's. All set at work to turn the captured intrenchments. There was great confusion in the intermingling of commands on a narrow front, and the Confederates now made most determined efforts to recover their intrenchments. Anderson sent troops from the left, three brigades of Hill's corps came from the right, and for the distance of nearly a mile, amid a cold, drenching rain, the combatants engaged in a desperate struggle across the breastworks. General Walker, the historian of the Second corps, says: "They fired directly into each other's faces; bayonet thrusts were given over the intrenchments; men even grappled with their antagonists across the piles of logs and pulled them over, to be stabbed or carried to the rear as prisoners. General Hancock had, as soon as the first success was achieved, brought up some of his guns to within 300 yards of the captured works, and these were now pouring solid shot and shell over the heads of our troops, into the space crowded with the Confederate brigades; he even ran a section of Brown's Rhode Island, and a section of Gibbs' Fifth United States, up to the breast works; and though the muzzles protruded into the very faces of the charging Confederates, the begrimed cannoneers for a time continued to pour canister into the woods and over the open ground on the west of the McCod house. The contest had settled down to a struggle for the recovery of the apex of the salient between the east and the west angle. . . . Never before since the discovery of gunpowder, had such a mass of lead been hurled into a space so narrow as that which now embraced the scene of combat. Large standing trees were literally cut off and brought to the ground by infantry-fire alone. If any comparison can be made between the sections involved in that desperate contest, the fiercest and deadliest fighting took place at the west angle, ever afterward known as 'The

Bloody Angle.' Here Wright's Sixth corps had taken post on coming up at 6'o'clock. . . . All day long the bloody work went on, and still the men of the North and of the South were not gorged with slaughter. The trenches had more than once to be cleared of the dead, to give the living a place to stand. All day long, and even into the night, the battle lasted, for it was not till 12 o'clock, nearly 20 hours after the command 'Forward' had been given to the column at the Brown House, that the firing died down, and the Confederates, relinquishing their purpose to retake the captured works, began in the darkness to construct a new line to cut off the salient.» During the day diversions were made on both sides to relieve the tremendous pressure in the centre. On the right of the Sixth corps, Warren, with a part of the Fifth, made an attack upon Anderson's corps and was repulsed with a loss of over 1,000 men. On Hancock's left Burnside's Ninth corps made an assault, and after lodging the head of column of Potter's division inside of Hill's works, it was attacked in flank and driven back with heavy loss. Later in the day General Early, commanding Hill's corps, advanced from his works to strike Burnside in flank, Burnside was met in motion and driven back to his works, and Early returned to his own lines. The Union forces engaged on the 12th numbered about 66,000 men, of whom 6,020 were killed and wounded, and 800 missing. The records do not show the number of Confederates engaged, nor their losses, but it is estimated that their total loss was between 9,000 and 10,000, of whom about 4,000 were captured.

On the morning of the 13th it was ascertained that the Confederates, failing to recover their lost intrenchments, had fallen back, and Colonel Carroll, with a brigade of the Second corps, went forward to reconnoiter, found them strongly intrenched on a new line at the base of the salient and after a sharp engagement withdrew. Dispositions were now made to turn Lee's right flank, and during the night of the 13th the Fifth corps, followed by the Sixth, moved over to the Fredericksburg road. The 14th was occupied in getting the two corps in position. The Confederates were found strongly intrenched on the Fredericksburg road in front of Spottsylvania Court House, and an attack was deemed inexpedient. During the day the Confederates attacked Upton's brigade of the Sixth corps, and compelled it to fall back from an advanced position, but the ground was immediately retaken by a brigade from the Fifth and one from the Sixth corps. When Lee saw that the Fifth corps had moved away from Anderson's front, Anderson's corps was shifted from the left to the extreme right, beyond the Fredericksburg road, and extended the line to Po River. Ewell still held the works in rear of the bloody salient. From the 12th to the 18th Grant was employed in constant reconnoitering and skirmishing, developing Lee's position and ascertaining if he could find a weak point in it; also in establishing a base at Aquia Creek, sending the sick and wounded there, drawing necessary supplies and awaiting the arrival of reinforcements from Washington to fill his depleted ranks. Early in the morning of the 18th the Second corps, supported by the Sixth corps on the right and Burnside's Ninth corps on the left, Warren assisting with his heavy artillery, made an attempt to force the lines held by Ewell's corps, at the only point where former efforts had met with even partial success. It was a failure. Under the fire of 29 guns of Carter's battalion, which swept all the approaches to Ewell's line, the attacking force was driven back before it came well within reach of musketry, with a loss of over 2,000 killed and wounded. Grant gave up further effort; deeming it impracticable to break Lee's lines at Spottsylvania Court House, he issued orders on the 18th with a view to a movement to the North Anna to begin at 12 o'clock on the night of the 19th. In pursuance to this plan, on the 19th the Second and Ninth corps were moved to the left, the Ninth corps taking position on the left of the Sixth, with the Second in reserve. Late in the afternoon Ewell's corps attempted a flank march around Grant's left to ascertain the extent of his movement and get possession of the Fredericksburg road. He was met by Tyler's division of new troops, who, being reinforced by Crawford's division of the Fifth corps and Birney's of the Second, after a severe engagement lasting until dark, drove Ewell back. Some of Ewell's forces, pushing to the rear on the Fredericksburg road, met Ferrero's division of colored troops, by whom they were repulsed. Ewell's loss during the day was about 900. Grant reports his own loss as 196 killed, 1,090 wounded and 249 missing. Ewell's attack delayed Grant's march for the North Anna 24 hours. On the night of the 20th the Second corps and a small force of cavalry under General Torbert were pushed through Bowling Green to Milford, followed on the three succeeding days by the rest of the army. Lee followed, and the lines around Spottsylvania Court House were deserted. The entire losses of the Union army around Spottsylvania Court House from May 8 to 19 inclusive are estimated by General Humphreys as 15,722 killed and wounded, and 2,001 missing, an aggregate of 17,723. The Confederate losses are not known, but were very severe. Consult 'Official Records' (Vol. XXXVI); Humphreys, A. A., 'The Virginia Campaign of 1864-65' (New York 1883); Walker, F. A., 'History of the Second Army Corps' (ib. 1886); Powell, W. H., 'History of the Fifth Army Corps' (ib. 1896); Pennypacker, 'Life of General Meade'; Grant, U. S., 'Personal Memoirs' (Vol. II, New York 1885-86); Early, J. B., 'The Last Year of the War for Independence' (ib. 1867); Lee, F., 'The Life of General R. E. Lee' (ib. 1894); Long, A. L., 'Life of General Lee' (ib. 1886); Gordon, G. H., 'A War Diary of Events in the War of the Great Rebellion' (Boston 1882); The Century Company, 'Battles and Leaders of the Civil War' (Vol. IV, New York 1887-88).

SPOUTING HORNS. Wave-cut caves along shore lines sometimes extend back some distance from the face of the cliff and by reason of a fracture or joint in the rock open up to the surface of the ground through a deep pit or well. During storms these frequently spout foam and water which has been driven into the cave by the waves. Such an opening is called a spouting horn or blowhole.

SPRAGUE, sprāg, **Austin Velorous Milton**, American inventor: b. Rochester, N. Y., 28 May 1840. He received special instruction in law, medicine and engineering, and in 1865 went to the Pennsylvania oil-fields where he engaged in perfecting methods of improved oil production. The frequent explosion of boilers, caused by the use of the brackish water of the Allegheny River, suggested to him a plan for raising the water of the river to a reservoir whence it could be supplied to the boilers. He successfully executed his plan, overcoming the difficulty caused by an elevation of 740 feet in a distance of 2½ miles. He has invented various household articles, improvements in laundry machinery, disinfectors, thermaerotherapic apparatus, introduced steam for the sterilization of surgical instruments and dressings in 1890, began experiments in 1891 with hot dry air for therapeutical purposes, since generally adopted, and introduced the use of steam for the disinfection of textile fabrics in 1899.

SPRAGUE, Frank Julian, American electrical engineer and inventor: b. Milford, Conn., 25 July 1857. While at high school in North Adams, Mass., he won competitive appointment to United States Naval Academy, from which he graduated with honors in 1878. He then became interested in electrical inventions and took a special course in physics under the late Admiral Sampson. Shortly after graduation he started on a tour of duty around the world, and was correspondent of the Boston *Herald* while General Grant was on the flagship of the Asiatic squadron. In 1882 he was appointed a member of the jury of awards at the Crystal Palace electrical exhibition, where he conducted all the tests on dynamo-electric machinery, electric lights and gas engines, his report being published in full by the Navy Department. In 1883 he passed examination for promotion, then obtained a year's leave, resigned and became assistant to Thomas A. Edison; a year later parted company with Mr. Edison and formed the Sprague Electric Railway and Motor Company, which, with his newly invented constant speed electric motor, began active exploitation for industrial purposes. Began inventions in electric railways in the early '80s, and conducted extensive experiments on the New York Elevated Railway in 1886. Is generally recognized as the pioneer of the modern trolley road, the first important installation of which was made by him at Richmond, Va., in 1887–88. (See TRACTION, ELECTRIC). In 1887 he invented the «multiple unit» system of electric train operation, by which several cars in a train are independently equipped, but all are under common control from several points. Has been an active exponent of underground electric traction. He was awarded a gold medal at the Paris Exhibition in 1889, the Elliot Cresson medal by the Franklin Institute in 1904, and the grand prize by the Louisiana Purchase Exposition for his inventions and developments in electric railways; also the Edison Medal, in 1910, for «inventive achievement in electrical science, engineering and arts.» He was a member of the electrical commission which had charge of the electrification of the New York Central Railroad terminals, and coinventor of its protected third rail; also member of the commission which investigated the possibilities of electrification of the Sierra Division of the Southern Pacific Company and was primarily responsible for the use of high potential direct current in railway work. He was chairman of committees on electricity and ship construction of the United States Naval Consulting Board; president of the Sprague Development Corporation and the Sprague Safety Control and Signal Corporation and inventor of system of automatic braking control of trains. He has written many scientific papers on electric motor and railways and kindred subjects.

SPRAGUE, Homer Baxter, American educator: b. Sutton, Miss., 19 Oct. 1829. He was graduated from Yale in 1852, studied at the Yale Law School and in 1854 was admitted to the bar. He entered the Union army in 1861, was commissioned colonel in 1864 and in 1866 was mustered out of service. He was a member of the Connecticut legislature in 1868, professor at Cornell in 1868–70 and was founder and first president of Martha's Vineyard Summer Institute. He was president of Mill's College, California, in 1885–86, of the University of North Dakota in 1887–91 and has since been engaged as a lecturer at Drew Theological Seminary, Chautauqua assemblies and elsewhere. He has written ‘Fellowship of Slaveholders’ (1857); ‘High School and Citizenship’ (1883); ‘Voice and Gesture’ (1874–1903); ‘History of the Thirteenth Connecticut Infantry’ (1867); ‘Inaugural Addresses’ (Adelphi Academy, 1870), Mills College, 1885); ‘The Place of Literature in a College Course’ (1887); ‘An Educational Party Needed’ (1886); ‘Free Text-books Necessary in School and College’ (1886); ‘The Pilgrim Fathers and Civil Government’ (1894); ‘The Assassination: Who is Responsible’ (1901); ‘The Nation's Honor Roll: Fiftieth Anniversary of Yale Class of 1852’ (1902); ‘Shakespeare's Alleged Blunders in Legal Terminology’ (1902); ‘The Right and the Wrong in our Civil War’ (1903); ‘Appreciation of Daniel Coit Gilman’ (1910); ‘Appreciation of George W. Shinn’ (1911); ‘The Elevation of His Satanic Majesty in Alpha Sigma Phi’ (1912); ‘Banquet Speech as Grand Senior President’ (1913); ‘Literal Metrical Version of the Book of Job,’ with ‘Essay on The Mystery of Undeserved Suffering in the Light of Evolution’ (1914); ‘Lights and Shadows in Confederate Prisons’ (1915); ‘Studies in Shakespeare’ (first series); annually for the last five years giving courses of lectures at Cornell on Shakespeare, Milton, The Book of Job, Goldsmith, The Story of Paradise Lost, etc.

SPRAGUE, William, American legislator: b. Cranston, R. I., 12 Sept. 1830; d. 1915. He entered the counting-house of his father, senior partner of the A. and W. Sprague Manufacturing Company, when 16, and afterward with his brother succeeded to the ownership of the business. He was governor of Rhode Island in 1860–63 and was among the most active of the «war governors.» He went to the front, participated in the first battle of Bull Run and in the Peninsular campaign and in 1863 was elected to the United States Senate, whereupon he resigned his governorship. He served in the Senate until 1875 and then resumed his manufacturing business. He was married in 1863 to the celebrated Kate Chase, daughter of Salmon P. Chase, from whom he was afterward divorced.

SPRAGUE, William Buell, American Congregationalist clergyman and author: b. Andover, Conn., 16 Oct. 1795; d. Flushing, N. Y., 7 May 1876. He was graduated at Yale University in 1815, studied theology at Princeton University and was ordained in 1819. He held pastorates at Springfield, Mass., in 1819–29, and at Albany, N. Y., in 1829–69. He made an extensive collection of manuscripts, pamphlets and other matter connected with both religious and secular American history, which at his death was divided between the State Library at Albany and Harvard University. He was author of several biographical works besides his most important work, 'Annals of the American Pulpit' (9 vols., 1857–69).

SPRAGUE, Conn., township in New London County, on the Shetucket River, 18 miles north of New London, on the New York, New Haven and Hartford Railroad. It has a Roman Catholic academy and manufactures include hospital supplies, paper and woolen and cotton goods. Pop. 2,551.

SPRAIN, the partial displacement or twisting of a joint with stretching, and more or less injury to the articulating apparatus; the ligaments, tendons and their sheaths being all involved in the injury, while sometimes even small portions of the articulating processes of bones are separated. All joints are liable to this accident, but the wrist and ankle are most frequently the seat of this injury; their liability arising from their immobility, compared with such a joint as the shoulder, which is more liable to dislocation. A sprain is attended with violent pain, and the sufferer feels sick and faint. Swelling and discoloration rapidly take place from extravasation of blood into the sheaths of the tendons and the other surrounding tissues, through laceration of the smaller blood-vessels. Subsequently the swelling is kept up in consequence of the effusion of serum from the incited action which occurs. Thus the joint is much deformed, and great care is required in examining the parts to guard against mistakes and to gain an exact knowledge of the nature of the injury so as to ascertain decidedly and at once whether it be a simple sprain, or whether there be fracture or dislocation. For this purpose the radiograph has been most valuable. If it is a simple sprain the part affected should be laid in an easy position on a pillow and confined in that position by broad slips of bandage crossing the limb and pinned at each end of the sides of the pillow. The part should at first be fomented for an hour or two with cloths wrung out of warm water; afterward it is to be wrapped in cloths wetted with a warm lotion, say of sugar of lead, one dram; opium, one dram; and boiling water, one quart. These cloths, when applied, should be covered with oiled sik or cotton to prevent evaporation. Absolute rest is the principal point to be attended to. To secure this, when there is much restlessness, it sometimes becomes necessary to use splints. In case of inflammation, a purgative may assist. After the pain abates and the swelling disappears, gentle rubbing with a soap and opium liniment is well, and a light flannel bandage should be applied. If the joint remains weak and stiff, stimulating frictions will be found useful, also the pouring of water on the part from a height, beginning with warm water, and after a time gradually reducing the temperature till the patient can bear it cold. After each application the part should be well rubbed, as otherwise it may become rheumatic; rheumatism is a very common occurrence in parts injured by sprains and fractures. Too great caution cannot be applied in bringing a joint which has been sprained into use, as many diseases of joints are brought on by mismanagement.

SPRECKELS, sprĕk'ĕlz, **Claus,** American merchant: b. Darmstadt, Hanover, Germany, 1828; d. San Francisco, Cal., 26 Dec. 1908. He came to the United States in 1846 and settled in Charleston, S. C. In 1856 he went to San Francisco, where he kept a store and later a brewery, and in 1863 established the Bay Sugar Refinery. He imported his raw materials from Hawaii where he acquired large properties, and owned in addition a beet sugar farm of 1,500 acres and a factory at Watsonville, Cal. By financing the Pacific Steamship Company he secured an advantage in ocean freight rates. He invented a new refining process and was by far the most active man of his time in the development of the sugar industry in the western United States.

SPRECKLES, Rudolph, American sugar refiner, capitalist and civic reformer: b. San Francisco, Cal., 1 July 1872. He entered his father's sugar refinery at Philadelphia when a youth, and at the age of 22 became owner of his father's interests in the Hawaiian Commercial and Sugar Company. He was markedly successful in his handling of its affairs and remained in Hawaii until 1898 when he sold out at a figure that netted him a large fortune. He then returned to San Francisco and engaged in banking. He has been prominent in the municipal affairs of San Francisco, lent material assistance at the time of the earthquake and organized and financed the exposure of the city's graft scandals in 1906.

SPREE, sprā, a river of Germany which rises near New Salza in Saxony at a height of about 1,200 feet in the Riesengebirge, and after traversing 227 miles flows by canal into the Havel at Spandau. It has also been connected with the Oder by a canal 17 miles in length. It has been deepened and canalized until it is navigable almost its entire length, and divides into several arms in passing through Berlin. One section of the stream spreads out into a wide marshy region known as the Spreewald.

SPRENGER, sprĕng'ĕr, **Jacob,** German theologian of the 15th century, who with Heinrich Krämer, was the author of the 'Malleus Maleficarum' or 'Hexenhammer' (1489), which first formulated in detail the doctrine of witchcraft, and formed a textbook of procedure for witch trials. They were appointed inquisitors under the bull 'Summis desiderantes affectibus' of Innocent VIII in 1484, and their work is arranged in three parts — 'Things that pertain to Witchcraft'; 'The Effects of Witchcraft'; and 'The Remedies for Witchcraft.' It discusses the question of the nature of demons; the causes why they seduce men, and particularly women; transformations into beasts, as wolves and cats; and the various charms and exorcisms to be employed against witches.

SPRIGTAIL DUCK, or **PINTAIL,** a very distinct species of fresh-water duck (*Dafila acuta*) the male of which is especially distinguished by the great prolongation and narrowness of the middle pair of tail-feathers. Both the females and the young of the latter have the tail-feathers very stiff and acute, but not otherwise peculiar. The sprigtail is a very handsome duck of more trim and slender appearance than most species and, including the tail, may reach two and one-half feet in length. It inhabits the entire northern hemisphere and on the American side breeds in the northern United States and Canada and winters in the Southern States and the West Indies. It is, however, especially an inland duck, and, both when breeding and migrating, associates with teals and mallards in reedy sloughs and about lake margins. Its food being chiefly vegetable, and consisting largely of wild rice, it is one of the best of table ducks. A swift flyer and one of the most alert and wary of ducks, it affords fine sport to the skilful gunner. The nest is always on the ground near the water and hidden in rushes or grass, often at the base of a tree. As with most of the ducks, it is lined with down and the 6 to 12 elongated elliptical eggs are of a plain grayish olive color. See DUCK.

SPRING, Gardiner, American Presbyterian clergyman, son of Samuel Spring (q.v.); b. Newburyport, Mass., 24 Feb. 1785; d. New York, 18 Aug. 1873. He was graduated from Yale in 1805 and was admitted to the bar in 1808, but abandoned law for the ministry. He was ordained pastor of the Brick (Presbyterian) Church, New York, in 1810, and continued in that pastorate until his death. He declined the presidencies of Hamilton and Dartmouth Colleges. His publications include ‹Essays on the Distinguishing Traits of Christian Character› (1813); ‹Obligations of the World to the Bible› (1844); ‹The Glory of Christ› (1852); ‹Brick Church Memorial› (1861), etc.

SPRING, Leverett Wilson, American educator: b. Grafton, Vt., 5 Jan. 1840. He was graduated from Williams College in 1863, studied theology at Hartford and Andover, and in 1868–81 was engaged in the Congregational ministry. He occupied the chair of English Literature at the Kansas State University in 1881–86 and the same chair at Williams College in 1886–1909 when he became professor emeritus. In 1885 he published Kansas — the first non-partisan account of the border struggles — and subsequent historians have generally accepted the conclusions set forth in the book. He has also published somewhat in magazines and elsewhere concerning the Kansas career of John Brown. The principal titles are «Old John Brown at Dutch Henry's Crossing,» «Catching Old John Brown,» «John Brown and the Destruction of Slavery» and «Colonel Walker's Visit to Old John Brown at Fort Little Sugar Creek.» The last two papers were read before the Massachusetts Historical Society. Another contemporary border leader — James Henry Lane — is considered in his «The Career of a Kansas Politician,» printed in the *American Historical Review*.

In 1888 he published «Mark Hopkins, Teacher,» in 1893 edited the publications concerning the centennial anniversary at Williams and in 1908 the «Induction of President Garfield.» He has also written sketches of Williams for ‹A History of Berkshire County› (1906) ‹A Cyclopedia of Education› (1913) and other publications.

SPRING, Samuel, American Congregational clergyman: b. Northbridge, Mass., 27 Feb. 1746; d. Newburyport, Mass., 4 March 1819. He was graduated from Princeton in 1771, was licensed to preach in 1774, became a chaplain in the Continental army in 1775, served under Arnold at Quebec and in 1776 left the army. He was ordained in 1777 and from then until his death was pastor of the church at Newburyport. He was instrumental in uniting the two parties in the Congregational Church, was a founder of Andover Theological Seminary, and one of the organizers of the American board of commissioners for foreign missions.

SPRING, the season of the year which follows winter and ushers in summer, and which in the United States includes the months of March, April and May. The first of these months, however, often presents, in the northern States, the harshest features of winter, although at other times genial and springlike. In the hot regions of Central and South America the seasons are divided into dry and wet, and the changes come suddenly and without any transitional periods. The astronomical spring in the southern hemisphere begins 23 September and ends 21 December, corresponding in some degree to the northern autumn.

SPRING, an outflow of water from the earth, or a stream of water at the place of its source. Springs have their origin in the water which falls upon the earth in the form of rain or snow and sinks through porous soils till it arrives at a stratum impervious to water, where it forms subterranean reservoirs at various depths. When the pressure of the water which fills the channels through which it has descended is sufficient to overcome the resistance of the superincumbent mass of earth, the water breaks through the superficial strata and gushes forth in a spring; or it may find some natural channel or crevice by which to issue. In descending and rising through various mineral masses the water of springs often becomes impregnated with gaseous, saline, earthy or metallic admixtures, as carbonic acid gas, sulphuretted hydrogen gas, nitrogen, carbonate of lime, silica, carbonate of iron, etc. When these substances are present in considerable quantity the springs become what are known as mineral springs. Warm and hot springs are common, especially in volcanic countries, where they are sometimes distinguished by violent ebullitions. Some springs run for a time and then stop altogether and after a time run again and again stop; these are called intermittent springs. Others do not cease to flow, but only discharge a much smaller quantity of water for a certain time, and then give out a greater quantity; these are called variable springs. Spring water is generally esteemed as the most desirable for drinking purposes and is bottled and sold in many cities. Consult Fuller, ‹Domestic Water Supplies for the Farm' (1912); Ries and Watson, 'Engineering Geology' (1914). See ARTESIAN WELL; GEYSER; MINERAL WATER.

SPRING, *in mechanics,* an elastic body, structure or contrivance, that yields under force or stress, but returns to its former position or shape when the stress is withdrawn. A strip of soft india-rubber exhibits great elastic qualities, but is not durable enough for use in machinery, and, therefore, springs are made mostly of steel, though many are of iron and brass. Springs are used for various purposes — diminishing concussion, as in carriages; for motive power, acting through the tendency of a metallic coil to unwind itself, as in clocks and watches; or to communicate motion by sudden release from a state of tension, as the spring of a gun-lock, etc.; others are employed to measure weight and other force, as in the spring-balance, as regulators to control the movement of wheel-works, etc.

A spiral spring is one shaped like the main spring or hair spring of a watch. Such a spring lies wholly between two parallel planes whose distance apart is equal to the width of the wire or tape of which the spring is made. They resist distortion, when used, for example, to actuate a watch or chronometer balance, with a force which is very closely proportional to the amount of the distortion. It is this property which insures the isochronism of the motion of a watch or chronometer balance. Helical springs, also commonly called spiral springs, are formed by winding wire into a helix about a right circular cylinder. If wound tight, they resist elongation, or if wound loose, with considerable spaces between the coils, they may be used to resist compression. They are also made in various forms to resist tortional strains. Where a stiff strong spring is desired, flat steel plates, often in groups tied together, are found efficient. These are called laminated springs. The certainty with which a metal spring yields to a given force has led to its employment in the spring-balance, a weighing device consisting essentially of a helical extension spring with a handle above and a hook or support for the thing to be weighed. Frequently a circular pointer is attached which indicates the weight on a dial. Air-cylinders with pistons or plungers are often used as springs, being found especially efficient in cylinder printing presses. Consult Routh, 'Rigid Dynamics'; Thomson and Tait, 'Natural Philosophy'; Kent, 'Mechanical Engineers' Pocket-book' (1916).

SPRING BEAUTY. See CLAYTONIA.

SPRING-BEETLES, or **CLICK-BEETLES.** See ELATER.

SPRING, or **GREEN, FROG.** See FROG.

SPRING-HALT, or **STRING-HALT,** a sudden involuntary twitching or convulsive movement of the muscles of either hind leg in the horse, the leg being raised unnaturally high and lowered with excessive force. Although it may not impair the usefulness of the animal, the defect lessens its value by injuring its gait and, to some extent, its appearance.

SPRING HILL, Nova Scotia, town in Cumberland County, 70 miles northeast of Halifax, on the Cumberland and the Intercolonial railways. There are important coal mines in the vicinity. Industries include meat packing and the manufacture of furniture and doors. Pop. 5,713.

SPRING HILL, Engagement at. After General Sherman had started from Atlanta, on his march to the sea (q.v.), General Hood, commanding the Confederate Army of Tennessee, marched northward from Florence, Ala., 19 Nov. 1864, to drive General Thomas from Nashville and back to the Ohio River. Thomas, who proposed to concentrate his own army on the line of Duck River and the Nashville and Chattanooga Railroad and to await expected reinforcements, withdrew his advance posts from Pulaski and other points to Columbia, on Duck River, where works were thrown up, covering the approaches from the south. He had there on the 26th about 23,000 infantry and 5,000 cavalry, only 3,500 of the cavalry being mounted. General Schofield was in command. His infantry consisted of two divisions of the 23d corps and the three divisions of Stanley's Fourth corps. Gen. J. H. Wilson commanded the cavalry. General Hood, preceded by General Forrest with 6,000 cavalry, appeared before Columbia on the 26th and with the three corps of Gens. S. D. Lee, A. P. Stewart and B. F. Cheatham, about 40,000 men, and threatened a crossing of the river above and below. During the night of the 27th Schofield withdrew to the north bank of the river, where he remained on the 28th. The two divisions of the 23d corps were placed in position in front of Columbia, holding all the crossings of the river in the vicinity, with Stanley's Fourth corps in reserve on the Franklin pike, ready to move whenever Hood should attempt a crossing above or below the town. Wilson's cavalry held the crossings above those guarded by the infantry. Forrest succeeded in crossing one of his divisions, above Columbia, before noon of the 28th, pushing Wilson's cavalry back on roads leading toward Spring Hill and Franklin, and Hood began crossing his infantry at daylight of the 29th at Huey's Mills, five miles above Columbia, from which a good road leads into the Columbia and Franklin pike, at Spring Hill, 15 miles north of Columbia, a road by which he could intercept Schofield's march to Franklin and strike him in flank. Wilson had dispatched Schofield at 1 A.M. of the 20th that Hood would undoubtedly cross the river at daylight and suggested an immediate withdrawal to Franklin. At daybreak Schofield sent Colonel Post's brigade up the river to ascertain if Hood had really crossed, and ordered General Stanley, with the two divisions of Wagner and Kimball, the trains and the reserve artillery, to Spring Hill, to cover that point and hold the road open for the passage of the entire army. At 8 A.M., Stanley was on the march. On reaching Rutherford's Creek, four miles from Columbia, Kimball's division was halted and faced east to cover the crossing against a possible attack, and remained in this position during the entire day. Stanley, with Wagner's division, pushed on, and it was nearing noon, when his head of column had approached to within two miles of Spring Hill, that he was informed that Buford's division of Forrest's cavalry was approaching from the east. The troops were quickly thrown forward and Bradley's brigade, deploying as it advanced, drove off Buford's men, just as they had driven back a small force of cavalry and infantry and were about to occupy the village. As the other two brigades came up, they also were deployed from the railroad on the north to the pike on the south, covering the village in a semi-circle, in which was placed the train. Bradley's brigade was sent half a mile to the front and right to occupy a knoll commanding all the approaches from the east. The greater part of the artillery was posted on a rise of ground south of the town. Scarcely had these dispositions been completed when Hood attacked. It was before sunrise when Cheatham's corps began crossing the river, Cleburne's division in advance. Hood accompanied Cleburne on the direct road to Spring Hill. Stewart's corps and Johnson's division of Lee's followed Cheatham, leaving Lee, with the remainder of his corps, in front of Columbia. Cleburne approached Spring Hill about 3 P.M., just as Bradley's brigade was taking position and immediately attacked it, and at the same time an attack was made by Forrest's cavalry at Thompson's Station, three miles north, on a small wagon-train pushing for Franklin, and a cavalry dash on the Spring Hill station northwest of the town. Cleburne's assault on Bradley was twice repulsed, but in a third front and flank attack Bradley was severely wounded and his brigade driven back to the edge of the village, where it was rallied and put in position to cover the wagon-train, part of which had reached Spring Hill. Cleburne endeavored to follow up his advantage, but was repulsed by the fire of eight pieces of artillery. Bradley's loss was about 150 killed and wounded; that of the Confederates was somewhat more. It was now sunset and the engagement ended. The result of it was that the Confederate infantry was checked when within 800 yards of the road, but their cavalry had gained the road both north and south of the town. Stanley, with his one division of not more than 4,000 men, was in a critical position; his nearest support was Kimball, who was more than eight miles in his rear; the other divisions of the army were still at Duck River. But fortunately for Stanley and the whole of Schofield's army, Hood's efforts to press the attack and gain the road miscarried, and Cheatham's corps bivouacked not more than half a mile from the road over which Schofield's army was obliged to pass from Columbia to Franklin. Stewart arrived after dark and formed on Cheatham's right, and by 8 P.M. two corps of Hood's army were in position facing the road and not over half a mile from it. There has been much Confederate contention as to who was responsible for the failure to seize the road and prevent Schofield's escape. Hood says: «Nothing was done. The Federals, with immense wagon-trains, were permitted to march by us the remainder of the night, within gunshot of our lines. I could not succeed in arousing the troops to action, when one good division would have sufficed to do the work.»

General Schofield, who had remained during the day at Columbia, started late in the afternoon, with Ruger's division and Whittaker's brigade, for Spring Hill, and when about three miles from the town, came upon the Confederate cavalry holding the road, which was driven off, after quite a skirmish. Leaving Whittaker to cover a cross-road a mile or two below the town, and to observe the Confederates, who could be seen standing around their camp-fires, Schofield continued his march with Ruger to Spring Hill, which he reached about 7 P.M., and two hours later moved on to force a passage at Thompson's Station. The Confederates withdrew on his approach, the road to Franklin was clear and Ruger took possession of the cross-roads. Schofield returned to Spring Hill, where, meanwhile, General Cox had arrived with his division of the 23d corps. Just before midnight Cox was ordered to start for Franklin, with instructions to take Ruger with him. He was fairly on the road by 1 A.M., of the 30th, at which hour the train of 800 wagons was started to follow Cox. At the very start the train was obliged to cross a bridge in single file, which made the movement so difficult and caused so much delay that Stanley was advised to abandon part of the train, to which he would not consent, and it was almost 5 A.M., before the rear of the train was fairly under way. As the head of the train passed Spring Hill it was attacked by cavalry and some wagons destroyed, but Wood's division, which had followed Cox from Duck River, was thrown on the flank of the train and the enemy driven off. It was near daybreak when the last wagon left Spring Hill. Kimball's division followed Wood's and at 4 A.M. Wagner followed Kimball, his skirmishers remaining until nearly daylight. Opdyck's brigade was rear-guard, and although hard pressed by Confederate cavalry, not a man nor a wagon was left behind. When the rear of the column was leaving Spring Hill, the head of it was at Franklin. Seldom has an army made such a narrow escape from destruction or capture. Consult ‹Official Records› (Vol. XLV); the Century Company's ‹Battles and Leaders of the Civil War› (Vol. IV, New York 1887–88); Van Horne, ‹History of the Army of the Cumberland› (Vol. II, Cincinnati 1875).

E. A. CARMAN.

SPRING HILL COLLEGE, a Roman Catholic institution located at Mobile, Ala. It was founded in 1830 by the Jesuits and remains under their control. It offers, in addition to the collegiate courses, a preparatory course and a commercial course. The degrees of A.B. and B.S. are conferred There is no endowment; the grounds and buildings in 1915 were valued at over $500,000; the library contained 15,000 volumes; the students in 1917 numbered 228, and the faculty 35.

SPRING LAKE, N. J., borough in Monmouth County, on the Atlantic Ocean, six miles south of Asbury Park, on the Pennsylvania and the Central of New Jersey railroads. It is patronized as a summer resort, has excellent bathing, good hotels and many fine summer residences. Pop. 1,492; summer pop., 20,000.

SPRING-RICE, SIR **Cecil Arthur,** British Ambassador: b. England, 27 Feb. 1859; d. Ottawa, Canada, 14 Feb. 1918. He was graduated at Balliol College, Oxford, and after serving as secretary to Earl Granville and as précis writer to the Earl of Roseberry, he entered the diplomatic service. He was secretary of the legation at Brussels, Washington, Tokio, Berlin and Constantinople, successively; became chargé d'affaires at Teheran, Persia, in 1900; British commissioner of the international debt at Cairo, Egypt, in 1901; and secretary of the embassy at Petrograd in 1903. He was Minister and consul general to Persia in 1906–08; Minister to Sweden in 1908–12; and in 1912 succeeded Lord Bryce (then Sir James) as British Ambassador to the United States. He remained in Washington as Ambassador until 1918, when after his arduous duties during the European War, he was given leave of absence. His health, however, had broken under the strain, and he survived but a brief time. While of a quiet and retiring habit he performed the duties of his office with distinguished ability and unfailing tactfulness through many trying periods. He was knighted in 1916.

SPRING TIDE, the tide which happens at the full moon, which rises higher than common tides. At these times the sun and moon are in a straight line with the earth, and their combined influence in raising the waters of the ocean is the greatest, consequently the tides thus produced are the highest. See TIDE.

SPRING VALLEY, Ill., city, Bureau County, on the Illinois River, and on the Chicago, Burlington and Quincy, the Chicago and Northwestern and the Chicago, Rock Island and Pacific railroads, 100 miles southwest of Chicago. It is the centre of a coal-mining region, and mining is the chief industry; it has about 50 manufacturing establishments, including pump factories, foundries, machine shops, etc. There is a national bank and newspapers. It has a public high school and a hospital. Pop. 7,467.

SPRINGAL, an ancient warlike engine, used for shooting large arrows, pieces of iron, etc. It is supposed to have resembled the ballista in its construction, being operated by the release of a wooden spring.

SPRINGBOK, a small South African antelope or gazelle (*Gazella euchore*), about 30 inches in height, and rich cinnamon-yellow on the upper parts, white on the belly, buttocks and face, and with stout, ringed, lyrate horns. It formerly gathered and migrated in enormous herds, but has now become uncommon in the more settled districts. It was remarkable among gazelles for its extreme agility and powers of jumping, and for stripe of long white erectile hairs along the spine. Consult Sclater and Thomas, ‹The Book of Antelopes› (London 1896), and the writings of South African travelers.

SPRINGER, Alfred, American chemist: b. Cincinnati, Ohio, 12 Feb. 1854. He took his Ph.D. at the University of Heidelberg in 1872, and from 1873 was a member of a firm of manufacturing chemists at Cincinnati. He was co-inventor of the torsion balance, which he patented, and he also patented the aluminum sounding-board for musical instruments. He made many valuable experiments, and has published descriptions of most of them. Author of ‹Glycocholic Ether› (1879); ‹Pentachloramyl Formate› (1881); ‹Reduction of Nitrates by Ferments› (1883); ‹A Latent Characteristic of Aluminum› (1891); ‹Increase of Segmental Vibrations› (1897), etc.

SPRINGER, Reuben Runyan, American philanthropist: b. Frankfort, Ky., 16 Nov. 1800; d. Cincinnati, 10 Dec. 1884. At the age of 21 he became clerk on an Ohio River steamboat and in 1830 became partner in the grocery firm of Kilgour, Taylor and Company, Cincinnati. In this business and in various investments he accumulated a large fortune which he used for a variety of benevolent enterprises. He contributed over $200,000 to the building of the Cincinnati Music Hall and gave other large amounts to the Art Museum, the College of Music and the Exposition Building.

SPRINGER, William McKendree, American jurist: b. New Lebanon, Ind., 30 May 1836; d. Washington, D. C., 4 Dec. 1903. He was graduated at the Indiana State University in 1858, and was admitted to the bar in 1861, beginning the practice of law at Springfield, Ill., In 1871 he entered the Illinois legislature and two years later was sent to Congress on the Democratic ticket. During his 10 successive terms he was prominent as temporary speaker, as chairman of the ways and means committee and as a participant in tariff and currency debates. He was the author of the resolution passed by the 44th Congress against the election of any person for a third term in the presidency, and served on the Potter committee which investigated the election of 1876, and also on the joint committee which reported the Electoral Commission bill. As chairman of the committee on territories he was the author of the bill organizing Oklahoma Territory, and of the bill admitting Washington, Montana, North Dakota and South Dakota as States. In 1895 he was appointed judge of the United States Supreme Court for the Northern District of Indian Territory and chief justice of the Court of Appeals of the Territory. In 1899 he removed to Washington and resumed the practice of law.

SPRINGFIELD, Ill., city, county-seat of Sangamon County and capital of the State, is in the centre of the great corn-belt, on the Illinois Central, the Chicago and Alton, the Chicago, Peoria and Saint Louis, the Wabash, the Cincinnati, Hamilton and Dayton and the Baltimore and Ohio railroads, 185 miles south of Chicago; 99 miles north of Saint Louis and near the Sangamon River. It is built on an undulating and well-wooded prairie and is beautifully laid out. The city is compactly built and has well paved and beautifully shaded streets. Springfield is the centre of the great coal mining industry of Sangamon County, whose product of coal in 1918 was 11,694,055 short tons, value $23,000,000, the largest of any county in the State. This industry in the same year employed 7,453 men and represents a population of fully 35,000. The Illinois State Fair is permanently located here. Large and expensive buildings have been erected at a cost of $1,650,000. The grounds are extensive and highly improved. The annual fairs have come to be little less than a liberal exposition.

The Capitol Building.— The most conspicuous public building is the State Capitol, which was completed in 1887. It stands in a park of eight acres, and cost over $4,500,000. The ground plan is in the form of a huge cross and the superstructure is of the modern classic style. The extreme length is 379 feet and the extreme width 286 feet. The exterior walls are of dressed Joliet limestone, the lofty porticoes of sandstone, supported by columns of polished gray granite. The edifice is three stories high and the massive symmetrical dome, the highest in the United States, is an object of great admiration.

The Lincoln Monument.— Among the historical attractions of Springfield are the Lincoln National Monument and the Lincoln residence. Both are owned by the State and are in charge of custodians. They are open daily to the public. The Lincoln National Monument stands in Oak Ridge cemetery, something over a mile north from the State House. The mausoleum contains the remains of President Lincoln, his wife, two children and one grandchild. The monument and the four heroic bronze groups, three representing the infantry, artillery and cavalry branch of the army, and the fourth, the navy, were designed by the sculptor Larkin G. Meade. It was dedicated 15 Oct. 1874 and cost about $350,000.

Public Buildings.— Among the prominent structures in Springfield are the United States Courthouse and Post Office, the County Courthouse, the Governor's Mansion, the State Arsenal and Armory, City Hall, Public Library, Reisch Building, Masonic Temple, Franklin Life Building, Ferguson Building, New Leland Hotel, Saint Nicholas Hotel, Sangamo Club, Illini Country Club, Springfield and Saint John's hospitals and David Prince Sanitarium.

Libraries.— In proportion to the size of the city the Springfield Lincoln Library, 185,000 volumes, at one time claimed to be the largest in the United States. It then contained over 58,000 volumes. Here also is the State Library of 70,000 volumes; the State Historical Library of 3,500 volumes, and many rare historical pamphlets, maps, etc., and the Supreme Court Law Library of 18,000 volumes.

Industries.— Springfield is the centre of an extensive coal mining, farming, horse and cattle breeding section and has large manufacturing interests. The invested capital in manufactures amounts to upward of $7,174,000, with an annual output of products valued at $11,441,706.14. The Illinois Watch Company has an immense establishment here, employing about 2,000 operatives, also Sangamo Electric Company, manufacturers of electric meters, large implement factory of Montgomery Ward and Company, powder plant of Western Cartridge Company. There are several large printing and publishing houses, textile works, planing and wood working mills, machine shops, woolen mills, breweries, engine, boiler and car works and manufactories of flour, clothing, boots and shoes, saddlery, soap, etc.

Banking and Finance.— On 1 March 1910, Springfield had a net public debt of $825,800 and the municipal receipts for a single year amount approximately to $500,000. This item of receipts does not include any school tax. In the same year there were five national banks with an aggregate capital of $1,450,000, one State bank, $300,000, and one trust company, $100,000. The average deposits in all these institutions was $22,000,000. There are 12 building and loan associations with 6,250 shareholders.

Government.— The city is governed on the commission plan, under revised charter regulations. The municipal expenses for a single fiscal year are approximately $450,000 exclusive of school expenses, and the municipal receipts for the same period, also exclusive of school tax, amounted to $500,000. The waterworks are owned by the city and have a daily capacity of 12,000,000 gallons. This capacity may be increased almost indefinitely without great cost. There is a complete sewage system of 101 miles, electric light plant, 25 miles of electric street railway, 442 acres of improved park land, value $515,452, and 85 miles of paved streets.

Education.— The expense of the public schools does not appear in the municipal financial statement, but there is raised annually by taxation a sum sufficient to maintain public schools and to erect new buildings as required. The total estimated value of school property is $2,243,450. The cost of maintaining the public schools for 1917–18, was approximately $453,445.38, which does include expenditures for new buildings and permanent improvements. The total enrolment for 1918–19 was 10,066. The total estimated actual value of property, subject to taxation, for school purposes for the year 1917–18 was $16,299,181 which represents ⅕ of true valuation. There were employed in the public schools for the year 1917–18 a superintendent, four special supervisors, two school nurses, an attendance officer, 18 principals and 260 teachers.

Religion.— Springfield has a total of 54 churches of all denominations, value $1,789,000, the Methodist leading with eight, the Baptist next with seven, Roman Catholic six, Presbyterian six, Episcopalian four, etc. There are two Hebrew synagogues and one Christian Science Congregation. Among the charitable institutions are the Home for the Friendless, the Home for Aged Women, the Home for Aged People under the control of the Roman Catholic Church, the Orphanage of the Holy Child and the Colored Old Folks' Home.

History.— Springfield was first settled in 1819 and was laid out in 1823 at which time it became the county-seat. It was first incorporated as a town in 1832 and was chartered as a city in 1840. It was selected as the State capital in 1837 and the State legislature assembled here for the first time in 1839.

Population.— (1890) 24,963; (1900) 34,159; (1910) 51,678; (1919, actual count) 71,969.

William H. Conkling,
Secretary, The Springfield Commercial Association.

SPRINGFIELD, Mass., city; port of delivery and county-seat of Hampden County; on the east bank of the Connecticut River; the terminus of the New York, New Haven and Hartford, terminus of the Connecticut River Division of the Boston and Maine, halfway station of the Boston and Albany Division of the New York Central; 99 miles west of Boston, 134 miles northeast of New York, 314 miles from Montreal — a logical railroad centre. The place is noted for its beauty, being laid out with wide and well-shaded streets and being especially attractive as a residential city. Four bridges span the Connecticut River here. The railroads entering the city built a union depot in 1889 at a cost of $500,000, which was replaced in 1919 by a new Union station at a cost of several million dollars, to meet the increased needs of the community. The elevated sections of the city command delightful views of the Connecticut Valley.

Manufactures.— The industries of Springfield represent a capital of $63,237,707, with an annual output valued at $75,159,074. The leading manufactures include firearms, motorcycles, railroad and trolley cars and supplies, candy machinery, envelopes, papeteries, dictionaries, cotton goods, skates, valves, magnetos, buttons, toys and kindergarten supplies sporting goods, corsets, tobacco products, forgings, machinery, art goods, confectionery, electrical supplies. The United States armory and arsenal are located here. The armory, the chief government arms factory, originally founded in 1794 and in continuous operation ever since, has a capacity of 24,000 rifles per week in addition to repair work, the rate of production varying with the demand. The arsenal was built in 1846 and is modeled after the East India House in London.

Commerce.— The value of imports for the year July 1918 to July 1919 was $4,000,000; the receipts for the same period, $52,500. The city has an efficient Chamber of Commerce with a membership of 1,755 and various commercial and social organizations.

Banks and Banking.— Springfield's seven national banks and trust companies with a combined capital of $3,350,000 have surplus and undivided profits of $5,900,000 and deposits of $48,382,492; there are three savings banks with a total of $50,000,000 in deposits; one safe deposit company with $500,000 capital; and a bank clearing house which cleared $153,378,375.24 in a recent year. Springfield's leading financial institution, the Massachusetts Mutual Life Insurance Company, has outstanding insurance of $490,793,291, and has paid $143,000,000 to policyholders. The Springfield Fire and Marine Insurance Company has $1,484,970,034 insurance in force and has paid $76,223,233.71 in losses since organization.

Public Buildings.— Among the leading buildings in the city are the $2,000,000 municipal group, consisting of an administration building, auditorium and Campanile Tower; city library, with its science and art museum buildings; the three high school buildings; county courthouse, home buildings of the Springfield Fire and Marine Insurance Company, Massachusetts Mutual Life Insurance Company, Third National Bank, Union Trust Company, Chapin National Bank, Hampden Savings Bank, United Electric Light Company and Springfield Gas Light Company and others.

Education.— The public school system embraces high, grammar, primary, manual training, vocational and kindergarten schools — 39 in all, with 680 teachers and 19,000 pupils. The evening trade school is said to be the first of its kind in the United States. The parochial schools enrolled 3,238 pupils in 1915. Springfield is the seat of the American International College, opened in 1885, and the International Young Men's Christian Association College. The city has a public library containing 200,000 volumes, with three branch libraries; and the Hampden County Law Library, dating from 1813. The facilities of the City Library are perhaps unrivaled in any city of similar size in the country; the library itself is of unusual efficiency. The system of public education is considered one of the most advanced in the United States. The city is the home of three famous publishing enterprises — Webster's Dictionary, the *Springfield Republican* and the *Springfield Union.*

Religion.—There are 65 churches in Springfield, of which 11 are Congregational, eight Methodist, eight Baptist, 14 Roman Catholic, one Unitarian, six Hebrew, three Episcopalian, two Universalist and other denominations.

Parks and Monuments.— There is an extensive public park system comprising 822.07 acres. Forest park has 729.14 acres and contains a collection of birds and animals. There are many small parks and squares throughout the city. In Merrick park stands a statue, «The Puritan,» by Saint Gaudens; on Court square and a soldiers' and sailors' monument and a statue of Miles Morgan by Jonathan Scott Hartley; on Pecousic Hill a bust of President William McKinley by Philip Martiny. Hampden Park, containing 54¼ acres, has been famous for its horse races and cycling tournaments.

Government.— The city is governed by a mayor elected biennially, and a bicameral council. The municipal appropriation in 1919 was $4,922,457.28, including $1,179,132.67 for the school department; $998,567.97 for the street department; $352,624.30 for the police department; $476,153.34 for the fire department. The waterworks are owned and operated by the city; the system cost over $2,000,000. In 1919 the city had a total debt of $9,026,500. The assessed valuation of real and personal property in the same year was $201,786,789.

History.— Springfield was first settled in 1636 by a party of emigrants from Roxbury under the leadership of William Pynchon. Until 1640, when it received the name of Springfield (from Springfield, England, the home of Pynchon), the town was known as Agawam. West Springfield, Chicopee and several of the neighboring towns were then included in its boundaries. On 5 Oct. 1675 during King Philip's War, the town was attacked by Indians and burned. In September 1786 during Shay's Rebellion (q.v.) it was the scene of a riot headed by Daniel Shay. In January 1787 occurred a skirmish between the State militia and 1,000 insurgents led by Shay, in which the latter was defeated. The city was incorporated in 1852.

Population.— Springfield had a population of 2,312 in 1800; (1850) 11,766; (1880) 33,340; (1890) 44,179; (1900) 62,059; (1910) 88,926; (1915); 103,000; (1919) 135,000.

Consult Burt, 'The First Century of the History of Springfield' (1888); Green, 'Springfield, 1686–1886' (1888); Barrows, 'The History of Springfield in Massachusetts' (1911).

Clifton D. Jackson,
General Secretary, Springfield Chamber of Commerce.

SPRINGFIELD, Mo., city, county-seat of Green County, on the Saint Louis and San Francisco and the Kansas City, Fort Smith and Missouri railroads, about 130 miles south of Jefferson City, the capital of the State. In the early part of the Civil War there occurred in the city and vicinity several battles. One, which is known as the battle of Wilson's Creek, took place 10 Aug. 1861; the Union forces were defeated and the Union general, Nathaniel Lyon, was killed. The city is on the ridge of the Ozark Mountains in a region known for its valuable deposits of zinc and lead. The climate is healthful and warm, temperate about all the year. Its industries are chiefly connected with the mining and marketing of lead and zinc. The chief industrial establishments are two large railroad shops, iron works, machine shops, wagon and carriage factories, furniture factories, flour mills and novelty works. It has an extensive trade in manufactures, lead and zinc and as a jobbing centre for a large part of the southern counties. The principal public buildings are the government buildings, county courthouse, municipal buildings, Saint John's Hospital, Springfield Frisco Hospital, the bank buildings, and several fine building blocks; Landers Building (10 stories), Heer-Andre Building (five stories), Holland Building, Y. M. C. A. Building are all of recent construction. The educational institutions are a State Normal School, Loretto Academy (Roman Catholic), Drury College (Congregationalist), public and parish elementary schools and a public library. There are the National and Confederate cemeteries, parks and in the vicinity many places where the scenery is most beautiful. Pop. (1890) 21,850; (1900) 23,267; (1910) 35,201; (1919 est.) 40,000.

SPRINGFIELD, N. J., township in Union County, on the Rahway River, and on the Delaware and Lackawanna Railroad, eight miles southwest of Newark. The chief manufactories are boot and shoe factories, paper mills and hat factory. Springfield is celebrated as the scene of a battle between the American and British forces, 23 June 1780. The British, under General Knyphausen, advanced from Elizabethtown about 5 o'clock in the morning. They were opposed by General Greene, but owing to the superior number of the enemy he was compelled to evacuate Springfield, which was then burned by the British. During the action the Rev. James Caldwell, chaplain in the New Jersey brigade, is said to have distributed the hymn books from the neighboring Presbyterian church among the soldiers for wadding, saying at the same time, "Now put Watts into them, boys." This battle prevented further advance on the part of the British. The American loss was about 72 and that of the British about 150. Pop. 1,300.

SPRINGFIELD, Ohio, city, county-seat of Clark County, on the Lagonda Creek and the Mad River, and on the Pittsburgh, Cincinnati, Chicago and Saint Louis, the Cleveland, Cincinnati, Chicago and Saint Louis, the Erie and the Detroit, Toledo and Ironton railroads, about 45 miles west of Columbus. Five lines of electric railways provide direct connections with the cities of Columbus, Dayton, Xenia, Urbana, Bellefontaine, Troy and Piqua, Lima.

Manufacturing.— The surroundings of the city were naturally rich in the possibilities of agriculture. An abundance of water power, utilized in woolen, cotton, flour and powder mills, enabled the early settlers to supply many of the needs of a pioneer community. In later years native genius turned the drift of the city's principal energies into the line of manufactures with the result that the fame of Springfield, as a manufacturing centre, is literally world-wide, and, especially, in respect to the fabrication of implements designed for the planting, cultivation and harvesting of the great staple crops. The developments of more recent years have given these manufactures a varied character, embracing electric motors and fans, leather belting, gas and steam engines, piano plates, machinery in vast variety, tools, mechanical appliances and factory supplies, in iron, steel and brass. Three million copies monthly, periodical publications of high class and national renown, and floral industries exceeded in aggregate extent by no city in the Union, contribute to Springfield's commercial prestige and distinction. Flour, medicine, food, wearing apparel, chemical, coffin, rubber and paper manufactures add variety to the list of Springfield's notable products. A recent industrial survey gives the total number of manufacturing establishments as 285, the amount of capital invested $30,000,000, the number of wage-earners 9,100, the average annual wages $5,800,000 and the average value of the annual products $29,500,000. There were seven large manufactories of agricultural implements, with an invested capital of $8,194,543. The 30 foundry and machine shops had a combined capital of $2,772,036. They had 2,197 employees, to whom was paid annually, on an average, wages amounting to $1,084,681. The value of the annual products was $3,097,910. Since 1900 there has been a notable increase in the amount of manufacturing.

Transportation and Commerce.— Ample shipping facilities afforded by the steam lines mentioned, ready access to the coal fields of various States and an excellent supply of natural gas fuel at 30 cents per 1,000 cubic feet are prominent factors in the city's advancement. At an early stage of the development of electric traction lines Springfield took rank as one of the chief centres of Ohio.

Local mercantile interests in lines both of wholesale and retail trade reflect the conditions of a thrifty, growing community.

The Commercial Club, embracing a membership of 700 representative citizens, is the agency for organized effort in the promotion of the growth of the city and the conservation of all its material interests. Four live and progressive daily newspapers give voice and direction to public-spirited sentiment and action.

Buildings and Municipal Improvements.— High School, $300,000, beautiful building patterned after Congressional Library; Memorial Hall, $250,000, seats 3,500. The United States post-office building was erected and equipped in 1890 at a cost of $150,000. The 11 rural free delivery routes add over 6,000 to the number served by the Springfield office. The Clark County courthouse, a handsome structure, is supplemented by a county office building, of striking architectural design and modern construction, the two buildings representing an expenditure of more than $200,000. The City Building cost $250,000 and is one of the finest edifices of its kind in the State, providing a city market 300 feet in length and a spacious auditorium in addition to quarters for municipal officers. Fronting the City Building are the handsome and graceful Kelly fountain and esplanade which cost $8,000 and were presented to the city by Oliver S. Kelly. The city hospital, founded by the liberal donations of Ross Mitchell and J. H. Thomas and endowed in the sum of $100,000 in government bonds by John Snyder, was erected and furnished at a cost to the city of $100,000. It is equipped with every appliance and convenience essential to its use. The city prison and patrol station, the cost of which was $20,000, is of modern design and construction. Three State fraternal homes have been erected on the hills which border the city, and a fourth, «The Eagles,» is under way. These homes are maintained by the brotherhood of the Masonic craft, the Independent Order of Odd Fellows and the Knights of Pythias. The city donated the sites on which the institutions are located, the funds being provided by voluntary contributions amounting to $100,000. Asa Smith Bushnell gave to the Masonic Home the sum of $10,000. Thousands of representatives of the fraternal orders annually visit these homes. The Lagonda Club has a handsome building which cost $25,000. The Young Men's Christian Association building, erected by the gifts of the people of Springfield, cost $90,000. Asa Smith Bushnell and Edwin S. Kelly each contributed $5,000.

Snyder Park, a tract of 275 acres, was the gift of John and David L. Snyder. Other donations by the same public benefactors were those of $25,000 for a memorial bridge and $200,000 in government bonds in endowment of the park. A memorial arch, erected to the memory of the Messrs. Snyder, by the people of Springfield, at a cost of $6,000, is to span the entrance to Snyder Park, and was dedicated 4 July 1904. Ferncliff, Springfield's principal burial ground, occupies a site of surpassing beauty. Springfield has an abundant supply of pure water. The waterworks system cost $800,000. Ample fire pressure is maintained, but the city fire department equipment includes three steam engines of large power.

Churches, Schools, Libraries.— The city has 60 churches, a large number of which are of modern construction and striking artistic beauty. There are 19 public school buildings, four Roman Catholic parish schools, two private business colleges and several private schools. The Springfield Seminary is one of the large city schools. The Wittenberg College, founded in 1845, by the Lutheran Church, has in attendance about 900 students. The Warder public library, which cost $100,000, is a gift from Benjamin H. Warder. It contains 35,000 volumes and is maintained by an annual appropriation. More than a score of literary clubs contribute to the culture and refinement which are marked characteristics of the people of the city.

Banks and Finances.— There are eight banks — six national and two savings banks. The national banks have a combined capital of $1,000,000; the six banks have deposits amounting to $5,214,520. There are two building and loan associations with assets in excess of $1,500,000. The bank clearings increased from $27,197,800 in 1910 to $41,194,503.02 in 1915. The gross receipts of the post office were in 1903, $163,041, and in 1915, $443,533.74. The aggregate financial transactions of the post-office, in 1910, were $1,000,000. The aggregate value of the real and personal property, as assessed for taxation, for the year 1915 was $58,712,650.

History.— The plat of the town was made in 1801 by James Demint. The city was chartered in 1850. The life of the city is told by the growth of its industries, charitable institutions, churches and schools. It has been the home of many noted men, among whom may be mentioned Joseph Warren Keifer (q.v.) and Asa Smith Bushnell. Pop. about 63,070.

SPRINGFIELD, S. Dak., city in Bon Homme County, near the Missouri River, 170 miles southeast of Pierre, on the Chicago, Milwaukee and Saint Paul Railroad. The Southern State Normal School is located here. Pop. 675.

SPRINGFIELD, Vt., village and township in Windsor County, on the Black River, 35 miles southeast of Rutland, and on an electric railroad. It has shoddy mills, machine shops and a brass foundry. Pop. town, 4,784; village, 3,250.

SPRINGFIELD (Mo.), **Military Operations at.** As the central point of southwestern Missouri, Springfield was an important place in military operations during the Civil War. After the engagement at Carthage (q.v.), 5 July 1861, Colonel Sigel retreated to Springfield, where he was joined by Gen. Nathaniel Lyon (q.v.) on the 13th, Lyon assuming command of all the Union forces, and calling for more to make head against the combined forces of Generals Sterling Price and Ben. McCulloch, a call that brought no response. On 1 August, hearing of the Confederate advance, Lyon marched from Springfield with 6,000 men and 18 guns against it, and next day at Dug Springs, 19 miles from the city, his advance encountered and drove back the Confederates under General Rains, with slight loss, and returned to Springfield on the 5th, which he thought he should be compelled to abandon, falling back either to Saint Louis or Kansas, as he was largely outnumbered. He reported the condition of affairs to General Frémont (q.v.) in command at Saint Louis, held his position, and advancing on 10 August, fought the battle of Wilson Creek (q.v.), nine miles southwest of Springfield, and was killed. His army, under Colonel Sigel, retreated through Springfield to Rolla, the Confederates following only to Springfield, which they held until the 25th. when they moved against Lexington. On 13 August, Frémont, hearing of the Wilson's Creek disaster, Lyon's death and the unobstructed retreat of Sigel on Rolla, sent reinforcements to Rolla, and at the end of September he left Saint Louis with an army of 38,000 men and 86 guns to take the field in southwestern Missouri, against Sterling Price (q.v.). His five columns were directed on Springfield. On 23 October, when about 50 miles from Springfield, Frémont sent Major Zagonyi, with about 250 men of his bodyguard and of the «Irish Brigade» (37th Illinois) to advance on the place. Zagonyi reached Springfield on the 25th. It was then held by about 1,000 recruits, some mounted and some on foot, and after several charges Zagonyi routed them, his loss being 15 killed, 27 wounded and 10 missing. Frémont occupied the place on the 27th with 21,000 effective men, and was about to advance and give battle to the Confederates, when (2 November) he was relieved in command by General Hunter, who withdrew the army to Rolla. Price reoccupied Springfield and began to recruit an army to recover Saint Louis, and had gathered some 8,000 men by 12 Feb. 1862, when he was driven from the place by General Curtis, Price retreating into Arkansas. Springfield now became a depot of supplies, and was well fortified. Early in January 1863 General Marmaduke (q.v.) with 4,000 mounted men and three guns, started from northern Arkansas on a raid into Missouri, and with a part of his command appeared before Springfield on the morning of the 8th. Gen. E. B. Brown, in command of the place, had but short notice of his approach, but gathered some militia from the adjoining country, which, with his regular command, convalescents from the hospitals and some citizens, gave him about 2,100 men. The fight began about 10 A.M. of the 8th and continued until dark. Marmaduke's men drove in parts of the line, captured one gun, carried some of the works and seized part of the town, but Brown held the strongest fort against all efforts to take it. On the morning of the 9th Marmaduke withdrew in the direction of Rolla, after a loss of 20 killed, 105 wounded and 26 missing. The Union loss was 14 killed, 146 wounded and 5 missing.

E. A. CARMAN.

SPRINGFIELD RIFLE. See ORDNANCE; SMALL ARMS.

SPRINGS, elastic contrivances of any kind having the power of recovering, by their elasticity, their natural state after being bent or otherwise forced — interposed between two objects in order to impart or check motion or permit them to yield relatively to each other. A common variety of spring is the carriage or automobile spring which diminishes concussion between the body and the frame or wheels. Another variety is the helical spring used to operate valves, etc. Modern carriage (carriages, automobiles, railway cars, etc.) springs consist of finely tempered pieces of steel so formed and fastened together that they strengthen each other, while allowing free play for the natural spring of each plate or leaf to act, and by so doing to absorb a large portion of the vibration and jolting caused by the wheels passing over inequalities in the road. The springs are mounted between the axles and framework, so that the wheels when passing over an obstruction or sinking into a hollow, compress or expand them, in the first instance, the motion being thus partly absorbed and partly passed on to the frame in a much lessened degree, and with the shock considerably deadened by passing through this elastic medium. Carriage and automobile springs are made in a variety of shapes. The elliptic spring consists of two halves fastened together with bolts; the top half is attached to the frame and the bottom half to the axle by bolts or slips in the centre. Varieties of the elliptic are the half-elliptic or semi-elliptic and the three-quarter-elliptic, in which an iron attached to the frame takes the place of one-half or more of the upper part of the ellipse. The grasshopper spring is arc-shaped with linking plates for attaching to shackle The volute spring is a type now in favor for heavy vehicles. When a spring made up of several leaves, plates or laminations is compressed, the various leaves must slide upon each other. This sliding motion is constantly taking place while the vehicle is traveling. To facilitate the slide movement the leaves are lubricated. The top member of the ordinary auto or carriage spring is of stout spring steel, with lugs forged on each end of it, by means of which it is attached to the shackles. It is furnished with lubricators and slots through which the oil flows to the various grooves. For high-speed vehicles it has been found advisable to lengthen the spring considerably and increase the circle of which the spring forms an arc. Consequently the spring is more nearly horizontal. In power-driven road vehicles radius rods are used to take up the drive and other thrusts which tend to alter the position of the rear axle in regard to the frame. The rods tend to locate the axle relatively to the frame. Horn plates are used to prevent the side movement of the springs, while in some cases rollers are used to prevent the axle from moving laterally relatively to the frame. The rollers come up against the surface of the horn plates. The helical spring is a length of metal of either round or rectangular section, wound round an imaginary cylinder. It is commonly miscalled a spiral spring. The corkscrew gives an idea of the helical spring. The spiral spring is a length of metal wound in a curve of continually decreasing or increasing radius. When wound it is quite flat. The main-spring and the hair-spring of a watch are spiral springs. The trembler spring is a flat spring used in coils and in contact breakers in order to make and break contact. The volute spring is a combination of the helical and the spiral spring. Helical and volute springs are in general use in modern machinery of several types, but are especially used in internal combustion engines to return the valves to their seatings. Other uses of the helical spring will instantly occur to every reader.

SPRINGS, natural outlets by which ground water reaches the surface. The more common small springs usually result from the outcrop of a nonporous layer below a porous stratum, the water which soaks down through the porous layer being forced to move laterally along the top of the impervious bed until it emerges. This type is usually called the hillside spring. On many steep hillsides or mountain slopes the soil acts as the porous layer, the bed rock as the impervious stratum, and whenever the soil is thin, the water is forced to the surface forming springs or swampy places. Sometimes the water seeps slowly down into the earth along an inclined porous bed, until it reaches a crack or joint, along which it rises rapidly. Such *fissure springs* are often of large size, and frequently have a high temperature, due to the great depth from which the water ascends. A third type of spring, common in limestone regions, results from the emergence of an actual underground river, which flows through a cave dissolved in the limestone. Such springs are frequently of enormous size, sometimes furnishing power to run local mills. Warm or hot springs are commonly termed thermal springs. The temperature varies greatly, ranging from normal to the boiling point. The heat may be due to the proximity of still uncooled volcanic rocks or to the great depth from which the water ascends along fissures. The hot springs of Yellowstone are probably of the former type, many warm springs of eastern United States appear to be of the latter sort. Practically all ground water carries mineral matter in solution. If this mineral matter is unusual in character or quantity, the spring is termed a mineral spring. Large quantities of lime cause calcareous springs; iron, chalybeate springs; silica, silicious springs; salt, saline or salt springs; hydrogen sulphide, sulphur springs. Many mineral springs are believed to have medicinal value, and much mineral water is bottled and sold. In 1913, mineral water to the value of $5,631,391 was reported in the United States alone.

SPRINGTAILS, a family of wingless insects of the order *Collembola* distinguished by the possession of an elastic forked caudal appendage, folded under the body when at rest, by the sudden extension of which these insects are enabled to make considerable leaps. The name is popularly extended to any thysanurous insect, as the snow-flea (*Achorentes nivicola*) and the bristletail (q.v.). Their scales are favorite test-objects for microscopes.

SPRINGVILLE, Utah, city in Utah County, 40 miles southeast of Salt Lake City, on the San Pedro, Los Angeles and Salt Lake and the Rio Grande railroads. The surrounding region is devoted to dairying and to fruit and stock raising, and there are gold, silver, iron and copper mines. Industries include canneries, beet sugar factories and railroad construction shops. Pop. 3,356.

SPRIT, a small boom or pole which crosses the sail of a boat diagonally from the mast to the upper aftmost corner, which it is used to extend and elevate. These sails are accordingly called sprit-sails. A sail attached to a yard hanging under the bow-sprit was also formerly so called.

SPROCKET, one of the projections («teeth») on a sprocket-wheel which engages the chain, also the name applied generally to any wheel upon which are radial projections that engage the chain passing over it. Perhaps the commonest form of sprocket is found in the bicycle, in which the pedal shaft carries a large sprocket-wheel which drives an endless chain which in turn drives a small sprocket on the axle of the rear wheel. The early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycle practice. Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

SPROCKET CHAINS, chains used for power transmission from one shaft to another, of the endless type, and working over sprocket or radical pointed-tooth wheels. They are much used in the bicycle, where the type known as the block-and-side-link is well nigh universal. In this type every other «link» is a block and is connected to the one following by two steel side plates between which the sprocket tooth moves. This type of sprocket chain was also extensively used in automobile construction but has been displaced by the roller type of chain, consisting of side-links held together by rivets, the latter encircled by a roller. These offer less friction as the chain takes its place on the sprocket. The chief advantage of the sprocket chain as a means of power transmission is its ability to work with very little friction loss without slippage, as is the case with belts and ropes. A fault of the chain is its noise, arising largely from the fact that as the chain stretches and the sprockets wear down in size, the two no longer fit together and the chain begins to rub upon and grind the teeth, thus increasing the working strain. In modern practice the silent gear chain has displaced all other types. Here the chain does not lie with its rivets or blocks between the sprocket-teeth, but carries them rather above, or outside the teeth, and each link is provided with points at one or both ends, which act as teeth to engage the teeth of the sprocket. These points grip the sprocket teeth as they come in contact with it and, having gripped it, they hold the chain in that position, which insures perfect-pitch line effect.

SPROULE, Thomas Simpson, Canadian physician and legislator: b. York County, Ontario, 1843. He was educated at the University of Michigan and at Victoria University, Cobourg, and for a short time practised medicine in Michigan. He later returned to Canada and was a member of the Dominion Parliament in 1878–1911. In 1915 he became a member of the Senate. He was throughout his career a strong supporter of Protestantism and worked earnestly for separate schools for Manitoba.

SPRUCE, or SPRUCE-FIR, a coniferous tree of the subfamily *Abietinæ* and especially of the genus *Abies*. One of the best known and typical is the Norway spruce (*A. excelsa*), which is indigenous in the north of Europe where it is the loftiest (often 125 feet) of forest trees, but has been transplanted as an ornament to all cool climates. The American spruces are described under Fir.

SPRUCE-BEER, a decoction of the young green tops of the black spruce, boiled and evaporated to the consistence of a thick syrup. Spruce beer of good quality may be prepared as follows: Essence of spruce, one half pint; pimento and ginger (bruised), of each five ounces; hops, one-half pound; water, three gallons; boil the whole for 10 minutes, then add of moist sugar 12 pounds (or good treacle 14 pounds); warm water, 11 gallons; mix well, and when lukewarm add a pint of yeast; after the liquid has fermented for about 24 hours it is ready for bottling. The beer is regarded as a diuretic and antiscorbutic, and is relished by many as an agreeable summer beverage.

SPRUCE PARTRIDGE. See Grouse.

SPUR, a metal instrument composed of a shank, neck, and prick or rowel, fastened to the heel of a horseman to goad his horse to greater speed. Its use cannot with certainty be traced further back than Roman times. Rowels first appeared early in the 14th century. The spurs of mediæval knights were gilt and those of esquires silvered. «To win his spurs» meant to gain knighthood. The Mexicans and Spanish-Americans generally wear large spurs, often of silver, except the rowel, and sometimes beautifully ornamented. The tendency in North America and western Europe is to use spurs much less than formerly.

SPURGE. See EUPHORBIACEÆ.

SPURGE-LAUREL. See DAPHNE.

SPURGEON, spėr'jŏn, **Charles Haddon,** English Baptist preacher: b. Kelvedon, Essex, 19 June 1834; d. Mentone, France, 21 Jan. 1892. He was the son of a Congregationalist minister and was educated at Colchester and Maidstone. In 1849 he was appointed usher in a school at Newmarket and soon after engaged in religious work at Cambridge and the neighborhood, being known locally as the «boy preacher.» Having joined the Baptist body he accepted the pastorate of a small Baptist congregation at Waterbeach at 18. Becoming known for his eloquence he was called, in 1854, to the pastorate of the Baptist chapel in New Park street, Southwark, and this, becoming too small for his audience, his congregation successively removed to Exeter Hall and the Surrey Music Hall, and ultimately built, in 1861, the great Metropolitan Tabernacle, which could accommodate 6,000 persons. Here he preached and labored for the rest of his life, his discourses attracting hearers from all parts of the world. Besides his ordinary ministrations and the publication from 1855 of a weekly sermon he founded the Pastors' College, at which the ministers of 36 London chapels were trained by him, the Stockwell Orphanage, almshouses, schools, etc. Earnestness, simplicity, directness, liveliness and not infrequently a genuine touch of humor were the chief characteristics of his sermons. Sagacity, common sense, straightforwardness, hatred for sham and falsity were prominent traits of his character as a man. He was the author of numerous volumes, among which the best-known are ‹The Saint and his Saviour› (1867); ‹John Ploughman's Talk› (1868); ‹Feathers for Arrows› (1870); ‹The Treasury of David,› a commentary on the Psalms — extending to seven volumes (1865–80); ‹Types and Emblems› (1875); ‹The Metropolitan Tabernacle and its Work› (1876); ‹Farm Sermons› (1882); ‹The Present Truth› (1883); ‹Storm Signals› (1886); ‹Salt Cellars› (1889); and he edited the monthly magazine *Sword and Trowel.* Consult ‹Life› by Shindler (1892) and ‹Autobiography Compiled by his Wife› (1900).

SPURGEON, Thomas, English Baptist clergyman, son of C. H. Spurgeon (q.v.): b. London, England, 20 Sept. 1856; d. 20 Oct. 1917. He was educated at the Pastors' College, studied art and visited Australia and Tasmania in 1877 and in 1879. In 1880–89 he was in charge of the Baptist Church at Auckland, New Zealand, and was evangelist of the New Zealand Baptist Union in 1889–93. From 1894–1917 he was pastor of the Baptist Church, Metropolitan Tabernacle, London. He was editor of *Sword and Trowel* and was publisher of ‹The Gospel of the Grace of God› sermons (1884); ‹Scarlet Threads and Bits of Blue,› poems (1892); ‹My Gospel,› sermons (1902), etc.

SPURRY, a plant of the genus *Spergula,* order *Caryophyllaceæ;* annual herbs, with the narrow or awl-shaped stipulate leaves fascicled at the swollen nodes of the succulent stems, and thus appear as if in whorls. The flowers are small and white in terminal, loose cymes, and have their parts in fives. *S. arvensis* is the common corn-spurry or yarr, a weakly spreading slender plant, generally glabrous, and with numerous flowers. It has been naturalized from Europe, where it is found in sandy fields, and is sometimes cultivated for green manure and for a rapidly growing fodder, or soiling crop, well liked by cattle and poultry. The sand-spurries are delicate plants of the closely allied genus *Tissa.* Found in salt-marshes and sea-beaches, with small pink flowers.

SPURZHEIM, spoorts'hīm, **Johann Friedrich Kaspar,** German phrenologist: b. Longwich, near Treves, Rhenish Prussia, 31 Dec. 1776; d. Boston, Mass., 10 Nov. 1832. He was educated at Vienna, where he became acquainted with Franz Joseph Gall (q.v.), the founder of the system of phrenology. To this study Spurzheim became exceedingly partial; and he soon joined Gall in making inquiries into the anatomy of the brain. They quitted Vienna in 1805 to travel and went in 1807 to Paris. From that period Spurzheim traveled and lectured in England, Scotland and Ireland. In 1832 he visited the United States and began his lectures in Boston, but death soon interrupted his labors. He published ‹The Physiognomical System of Drs. Gall and Spurzheim› (1815); ‹Sur la Folie› (1818); ‹Essai philosophique sur la Nature morale et intellectuelle de l'Homme› (1820); ‹A View of the Elementary Principles of Education› (1821), etc. Consult Carmichael, ‹Memoir of the Life and Philosophy of Spurzheim› (1833). See also PHRENOLOGY.

SPUYTEN DUYVIL (spī'tn dī-vĭl) **CREEK,** a tidal channel connecting the Hudson River with the Harlem and forming the northern boundary of Manhattan Island, New York. Its name is derived from the Dutch «*Spyt den duivel*» (in spite of the devil), and is supposed to have been derived from the following circumstance: When the English fleet appeared in New Amsterdam (New York) Harbor, the governor's trumpeter was sent to warn the farmers up the Hudson and summon them to the defense of the city; on reaching this creek he found no ferryman willing to take him across on account of the high wind, and swore to cross the stream «*spyt den duivel*»; but was drowned in the attempt to swim across. The creek is crossed by a railway drawbridge near the Hudson.

SPY, *in military usage,* a secret emissary sent into the enemy's territory or encampment to inspect their works, ascertain their strength or movements and report thereon to the proper officer. As the service is most dangerous, for it is the custom when a spy is caught to put him to an ignominious death, a general has no right to compel any person, whether a subject of his own or the enemy's country, to undertake it. The proper business of a spy is to obtain intelligence and he must not be employed to take the lives of any of the enemy. An officer or soldier found within the enemy's lines should not be treated as a spy if he is clothed in his own uniform, but is dealt with either as a deserter or prisoner of war; but if wearing his enemy's uniform or civil dress he is liable to be hanged. The American Civil War offered many instances of great daring on the part of spies, Union and Confederate, and in numerous cases their exploits resulted in tragic deaths. While spies are undoubtedly induced to perform their perilous work, in numerous cases, by hope of reward, yet there have also been many examples among them of pure and devoted patriotism. In the Russo-Japanese war several Japanese officers of rank and family position, who sought, in the disguise of coolies, to blow up a railway bridge in Manchuria, were promptly hanged as spies, and the spy record of the World War would fill many volumes.

SPY, The. 'The Spy; a Tale of the Neutral Ground,' Fenimore Cooper's second novel, published in 1821, was the earliest American novel to win wide and permanent fame and may be said to have begun the type of romance which dominated native fiction for 30 years. The share of historical fact in the story, indeed, is not large, but the action takes place so near to great events that the characters are all invested with something of the dusky light of heroes, while Washington moves among them like an unsuspected god. The book is full of swelling rhetoric and the ardent national piety of Cooper's generation. Fortunately Cooper saw the advantage of making his British out to be enemies worth fighting, if only in the interest of the plot, which ranges back and forth over the neutral ground between the two armies with great haste and sweep. To rapid movement Cooper adds the merit of a very real setting. He knew Westchester County, where he was then living, and its sparse legends as Scott knew the border. The topography of 'The Spy' is drawn with a firm hand. With his characters, Cooper is not uniformly successful. Accepting for women the romantic ideals of the day, he cast his heroines in the conventional mold of helplessness and decorum. The less sheltered Betty Flanagan, no heroine at all in the elegant sense, is amusing and truthful. Of his men, too, the gentlemen are little more than mere heroes, whatever the plain fellows may be. But Harvey Birch, peddler and patriot, his character remotely founded upon that of a real spy who had helped John Jay during the Revolution, is essentially memorable and arresting. Gaunt, weather-beaten, canny, mysterious, he prowls about on his subtle errands, pursued by friend and foe, sustained only by the confidence of Washington, serving a half supernatural spirit of patriotism which drives him to his destiny, at once wrecking and honoring him. This romantic fate also condemns him to be sad and lonely, a dedicated soul. No character in American historical fiction has been able to obscure this first great figure. H. L. Barnum's 'The Spy Unmasked; or Memoirs of Enoch Crosby, alias Harvey Birch' (1828; 5th ed., 1864) claimed to identify the original.

CARL VAN DOREN.

SQUAD, in the army, a small body of troops assembled for drill, inspection or other purposes. A troop of cavalry or a company of infantry is usually divided into as many squads as there are sergeants or drill-instructors to train them. The awkward squad is composed of those recruits who have not received sufficient training to take part in regimental drill.

SQUADRON, (1) the principal division of a cavalry regiment in some European armies, commanded by a captain, and usually of 100 to 150 horsemen. This body is subdivided into two troops. Three to six squadrons form a regiment. When in line one yard in the length of the front is allotted for each man and horse; the space in line between every two squadrons is equal to one-quarter of the extent occupied by each squadron. (2) *In the navy* a squadron is a number of vessels employed on any particular service or station, smaller than a fleet, under the command ot a commodore or junior flag-officer. A United States navy squadron may consist of 11 or less battleships. When a large fleet is assembled, they are usually divided into the van, centre and rear squadrons.

SQUARCIONE, Francesco, frän-chĕs'-kō skwär-chē-ō'nē, Italian painter: b. Padua, 1394; d. there, 1474. In early life he traveled in Greece and Italy, where he became acquainted with the masterpieces of ancient sculpture. He formed a collection of busts, torsos and bas-reliefs (probably casts) and founded the Padovan school of painting, which produced Mantegna and Zoppo. One of his latest works is 'A Madonna and Child,' now in the possession of the Lazzard family at Padua.

SQUARE, (1) *in geometry,* a quadrilateral figure, both equilateral and equiangular, or, in other words, a figure with four equal sides and equal angles. In measuring superficial areas it is only necessary to multiply one side by itself to have the area of the square, because each of the sides may be considered as the basis or as the perpendicular height. Thus a square the sides of which measure four feet is equal to 16 square feet, that is, 16 squares each one foot high and one foot broad. To square a figure (for example, a polygon) is to reduce the surface to a square of equivalent area by mathematical means. It has often been attempted to square the circle, but this can be done only approximately. (2) *In arithmetic and algebra* the square of a number is the number or quantity produced by multiplying a number or quantity by itself. Thus 64 is the square of 8, for $8 \times 8 = 64$. (3) *In military tactics,* a body of infantry formed into a rectangular figure with several ranks or rows of men facing on each side, with officers, horses, colors, etc., in the centre. The front rank kneels, the second and third stoop and the remaining ranks (generally two) stand. This formation is usually employed to resist a cavalry charge. Hollow squares are frequently formed with the faces fronting inward when orders and instructions, etc., are to be read and the like. (4) Any of a great variety of objects more or less rectangular, as a city block, a pane of glass, a simple measuring instrument for determining right angles, usually made in the form of an L or T. A geometric square, however, may be quite a complicated instrument.

SQUARE ROOT. Arithmetical.— The square root of a number is one of its two equal factors. It is indicated by the fractional exponent (½) placed at the right, and above the number, thus $16^{\frac{1}{2}}$, or by the radical sign ($\sqrt{16}$). The two equal factors of 16 are 4 and 4, either one of which may be taken as its square root. The square roots of many numbers are approximate only and are represented by a whole number and a decimal, the latter carried out as many places as the approximation is desired, as example, $\sqrt{19} = 4.358899+$. The square root of fractions may be found by extracting the root of the numerator and denominator, but a more practical method is to extract the root of the resulting decimal. Illustration of the method employed in finding the square root of 576:

$$\begin{array}{rrl} & 576 & (20 \\ 20 = & 400 & \;\;4 \\ & \overline{} & \overline{}\,. \\ 2 \times 20 = 40) & 176 & 24 \\ (40 + 4) \times 4 = & 176 & \\ & \overline{} & \end{array}$$

Since the number 576 has three figures its square root will be composed of tens, and units. The number of tens in the root will be 2, and the square of 2 tens, or 20, will be 400. (See Fig. 1). But inasmuch as there is still a remainder of 176, such additions must be made to the square as will take up this remainder, and still keep the figure a perfect square. The necessary additions are the two rectangles B and C and the small square D (see Fig. 2). The remainder 176 divided by the length of the rectangles, 2 × 20, will give the width of the additions, which is 4, and this width is also the side of the small square D; therefore the total length of the additions will be 40 + 4, and the area of the additions 4 times this length, or 176, which completes the square whose area is 576, and whose square root is 24.

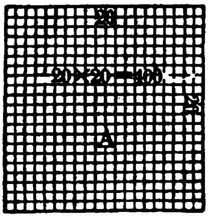

FIG. 1.

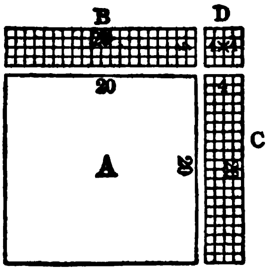

FIG. 2.

Algebraic.— The preceding rules, with the exception of those relating to decimals, are applicable to algebraic quantities. The square root of an algebraic quantity, however, may be positive or negative.

The square root of a negative quantity is imaginary, and is usually factored into two quantities, one of which is real, and the other expressed by $\sqrt{-1}$. Thus the square root $\sqrt{-ab} = \sqrt{ab}\ \sqrt{-1}$.

The square root of algebraic quantities affected by other roots is indicated by multiplying its exponent, or index by 2, wherever possible the square root is first extracted, and the multiplication avoided.

The indicated square root of an imperfect square, in algebra, is called a quadratic surd. To extract the square root of a binomial surd, such as $\sqrt{a + \sqrt{b}}$, there are many methods; one is to reduce the surd term so that its coefficient shall be 2. Then separate the rational term into two parts whose product shall be the quantity under the radical sign. Extract the square roots of these parts, and connect them by the sign of the surd term.

Square root finds its application in all branches of mathematics, and in the natural sciences. Its use is fundamental.

SQUARING THE CIRCLE. See QUADRATURE OF THE CIRCLE.

SQUASH, a garden vegetable, the fruit of several species of the genus *Cucurbita* (order *Cucurbitaceæ*). They are vine-like tendril-bearing herbs, with large rough leaves on long hollow stalks, have large monœcious yellow flowers borne singly in the axils of the leaves, and followed by hard fruits of many forms and sizes. They are natives of warm climates, but are cultivated as annuals in temperate regions throughout the world. The summer squashes are derived from *C. pepo* mainly, and the winter kinds principally from *C. maxima,* though *C. moschata* also enters into many varieties. The first species, which is also parent of the pumpkin (q.v.), has given rise to the scallop, pattypan and summer crookneck squashes, the first known in southern markets as simlins, symblings and various similar names; the third is the parent of the winter and Canada crookneck, China and cushaw squashes. *C. moschata* and *C. pepo* have been crossed artificially, but none of these species are known to cross under field conditions, and the other pairs among these three species have not been crossed artificially.

Squashes thrive best in long seasons, in warm situations and upon light, loamy but only moderately rich well-drained soils. In the North they are often planted too early and are injured by late spring frosts and they often fail to mature all their fruits because the early frosts of autumn injure the vines. To obviate these results the plants are frequently started under glass upon pieces of sod or in pots and are transplanted to the field when seeds could be safely planted. About three weeks is the maximum time to allow between sowing and transplanting, the plants being likely to be too large for best results if older. The soil should be deeply and finely prepared and marked off in checks prior to sowing. For «bush» and summer squashes 4 x 4 feet is the usual distance; for winter and viny kinds 8 or 12 feet. Most growers allow only two or three plants to each «hill,» but plant 12 or even more seeds in the hills to guard against contingencies. The ground is kept cleanly cultivated until the vines prevent tillage. In the North, the vines should not be allowed to root at the joints because this prolongs the vegetative period, and here if one fruit sets long in advance of others upon a vine it is usually cut off since other fruits often fail to form. Two or three squashes are usually calculated upon per vine for winter varieties; summer kinds will often continue to bear until frost if the fruits are removed as soon as they attain edible size. Winter squashes may be successfully stored for several months but they should be gathered before frost, handled with extreme gentleness to avoid the slightest bruise even to the hardest specimens and kept at a rather low temperature in a dry atmosphere until needed for use.

Several insects feed upon the squash and sometimes prove troublesome when very abundant. Probably the best known of these is the squash bug (*Anasa tristis*) which appears from its hibernating quarters about the time the earliest plants appear. The eggs are laid upon the foliage and in about a week the scarlet larvæ emerge. They pierce the tissues with their stout beaks and suck the juices and as they grow they turn gray, becoming dark brownish gray when mature. The adults are about an inch long and there is a seemingly constant succession of overlapping broods from midsummer onward, insects in all stages of development being found. There are, however, in the North usually only two broods. The plan found most satisfactory in controlling these insects is destruction of the vines and immature fruits as soon as the crop can be gathered in the autumn. The squash vine borer, the squash lady-bird beetle, the cucumber beetle and several other insects also feed upon the squash. See CUCUMBER; MELON, etc.

SQUATTER, a person who settles on public or new lands without any title. In Australia the sheep-farmers, who occupy the unsettled tracts of land as sheep-runs under lease from government at a nominal rent, are also called squatters.

SQUATTER SOVEREIGNTY, a term designating the right of occupation acquired through undisturbed possession of public lands for a certain number of years by settlers originally unauthorized. Public lands or public domain belonging either to the nation or individual States, from the necessities of government and the usual operations of capitalists, became an object of speculation, and were accordingly sold from time to time in large tracts to capitalists and speculators, who generally resided at a great distance from the lands thus purchased by them. Their lands being thus entirely out of their view and control were of course continually intruded upon and possession taken here and there by emigrants from the more populous towns, who put them under cultivation and erected houses and buildings upon them for the common purposes of agriculture. These settlers came to be familiarly known as squatters, a name naturally derived from the act of settling upon lands in the manner practised. By the lapse of time the mere possession of these settlers, without any formal title to the land, ripened into what they considered to be a right, although the titled proprietors of the soil were frequently wholly ignorant of such occupation of their property. Often, after a long series of years, it became impossible to dispossess them, whatever their possession, in its origin, may have been. It is true that the proprietors might, and did institute legal processes and recovered judgment against the occupants, but the officers of justice frequently could not execute the sentence of the law and dislodge them from their possessions. Instances not unfrequently occurred where the officers of justice and the proprietors themselves, or their agents, were shot at or suffered other acts of violence from the occupants. In this critical exigency, which threatened the public welfare, and which was perhaps exaggerated by those men who wished to avail themselves of the occasion to obtain popularity for political purposes, it was thought necessary to pass laws which were to a great extent similar to the Roman agrarian laws and which deprived the technical proprietor of a portion of his rights and transferred them to the possessor who had occupied and improved the land.

Under colonial laws and usages a title to land by mere occupancy could not be acquired by a possession short of 60 years. By one of the first laws promulgated by a State of the republic on the question, the legislature of Massachusetts in 1808 shortened this term to 40 years.

This essential change in the legal rights of the titled proprietors, in violation of what they deemed to be the fair intent and meaning of their contracts, caused much excitement and dissatisfaction among them. Generally, it may be said that there evidently was hardship on both sides; it was not equitable, on the one hand, that the proprietor should be deprived of his land, nor on the other that an innocent occupant who had been suffered to remain in possession for 30 or 40 years, undisturbed by the proprietor, should be suddenly expelled and stripped of the fruits of the labor of a whole life. By way of alleviating the difficulties of the case, it was provided in this law of 1808, agreeable to a well-known principle of the Roman code, that when the proprietor should institute a process to recover his land the occupant should have a right to claim an allowance for the value of the improvements which he had made upon the lands thus occupied by him, and which were called in the Roman law *meliorantes* or *melioramenta*, and by analogy in the popular language of New England, *betterments, improvements*, which might have been taken to convey the idea of *melioramenta* being already used in New England in the sense of occupation.

In practice, the law was more unequal in its operation as regarding the proprietor of the land, from another circumstance; for he being usually a non-resident or stranger, and the occupant being an inhabitant of the same territory from which the jury was taken who were to try the question of right between the parties, the proprietor was in the more danger of suffering from the prejudice or hostility of the jury.

The law remained in operation, and the lapse of time rendered it less and less unequal and injurious in its effects; finally it became the model of similar laws for all other States of the Union which respectively claimed the right to legislate upon the matter according to local needs.

And from this claim for legislation according to local needs arose the cry of «popular sovereignty» which became identified with «squatter sovereignty» in that its adherents, especially from 1847 to 1861, advanced and strenuously advocated the theory that the question of slavery in a State or Territory should be decided by the electorate of the State or Territory and not by Congress. See also PUBLIC LANDS, BOUNTIES.

SQUAW-BERRY, or SQUAW-HUCKLEBERRY, the deerberry, genus *Vaccinium stamineum*, a bush native to the eastern part of the United States. The bush rarely grows to any height and the berry is very unsavory. The bush, however, has pretty racemed flowers with white recurved corolla and yellow stamens.

SQUAWFISH, a fish of the genus *Ptychelus oregonensis*, inhabiting the fresh water bodies in California, and commonly known there as the «Sacramento pike.» It grows sometimes to be five feet in length and is one of the largest species of the carp family to be found in American waters.

SQUAWROOT, skwâ'röt, a fleshy plant, *Conopholis americana,* of the family *Orobanchaceæ,* native of the eastern part of the United States. It is generally root-parasitic and found among fallen leaves in oak woods. It is leafless, grows to a height of three to six inches and as large around as a man's thumb. Fleshy scales entirely cover the plant and the flowers are in axils of these scales. The blue cohosh, *Caulophyllum thalictroides,* is in rare instances also called squawroot.

SQUAXON. See SALISHAN INDIANS.

SQUETEAGUE, skwē-tēg'. See WEAKFISH.

SQUID, any 10-armed cuttlefish (q.v.; also CEPHALOPODA), not a sepia or spirula (q.v.). The squids are divisible into several groups and range in size from less than an inch (*Idiosepion*) to 75 feet or more in length, when the arms are outstretched. They are found in all oceans, and most of the genera are nearly cosmopolitan. The small families *Sepiadariidæ* and *Idiosepiidæ* are confined to the Pacific, and the *Chiroteuthidæ* to the Atlantic, but the others are practically world-wide in their distribution and pelagic as well as littoral in range. Together these families form the dibranchiate suborder *Decapoda.* Most of the squids belong to the shore-haunting *Loliginidæ* or else to the pelagic family *Ommastrephidæ.* In both, the gladius «pen,» or «cuttlebone,» is long and chitinous instead of broad and calcareous as in the sepias proper. The old European names «calamary» or «pen-and-ink fish» refer to the pen-shape of this internal support, which is nearly or quite as long as the back, and to the reservoir of inky dye which they discharge when alarmed. In the *Loliginidæ* it is flat, pointed in front and has the shaft keeled on the ventral side; in the *Ommastrephidæ,* it is horny, narrow and terminates in a hollow cone at the posterior end. There are many species, both existing and fossil.

The common squid of the north Atlantic coast of the United States is *Loligo pealii,* which after several years of slow growth become 12 to 18 inches long. The color when living is very changeable, owing to the alternate contraction and expansion of the color-vesicles (chromatophores, q.v.), but red and brown tints prevail, and the general effect is great beauty. These squids lay their eggs in midsummer in large bunches of long gelatinous capsules on shelly and weedy bottoms and along rocky coasts. This species is often found in great numbers in summer close to the shore of Maine and northward and many of them are stranded on the beaches. All the squids are caught by sea fishermen to use as bait.

The «flying squids» of the genus *Ommastrephes* are so named from their habit of leaping from the sea, sometimes to such a height as to land them upon the decks of vessels. They are met with chiefly far from land; but one small species (*O. illecebrosa*) is frequently seen in large companies near the New England coast. Verrill describes its attack upon schools of small fishes in which it resembles squids generally. All the species are fish-eaters and are themselves the prey of larger fishes and of porpoises and the various whales, turtles, etc., of the sea. «In attacking the mackerel,» says Verrill, «they would suddenly dart backward among the fish with the velocity of an arrow and as suddenly turn obliquely to the right or left and seize a fish, which was almost immediately killed by a bite in the back of the neck with the sharp beaks . . . cutting out a triangular piece of flesh.» They are mainly nocturnal in activity.

To this family belong the «giant squids» of the genus *Architeuthis,* which occur in Arctic and sub-Arctic seas, and are occasionally stranded on the shores of Norway and Greenland, or found in part in the stomachs of captured sperm whales, for which they form an important food-resource. These giants, which probably reach a great age and frequently exceed 50 feet in length, including the arms, have such strength that they would drag down a large boat, if given an opportunity, and cases are known where men in the water, seized by even small specimens, have escaped with great difficulty. Preserved remains and papier-maché models may be seen in many museums.

Consult Cook, ‹Mollusca› (London 1895); Kingsley, ‹Standard Natural History› (Vol. I, Boston 1885); Verrill, ‹Invertebrates of Vineyard Sound› (Washington 1874).

SQUIER, skwīr, **Ephraim George,** American archæologist: b. Bethlehem, N. Y., 17 June 1821; d. Brooklyn, N. Y., 17 April 1888. He engaged for a time in teaching, was connected with the village newspaper and studied engineering. He was employed on the *New York State Mechanic* in 1841, and in 1843 went to Chillicothe, Ohio, where he was on the staff of the *Scioto Gazette* and also clerk of the legislature. Soon after removing to Ohio he began a series of investigations concerning the ancient mounds in Ohio and the neighboring States. In 1849 he was chargé d'affaires to the Central American States, was secretary of the Honduras Inter-oceanic Railway Company there in 1853, in 1863–65 he was United States commissioner to Peru, and appointed consul-general to Honduras in 1868. While performing the duties of these various offices he prosecuted an extensive series of researches and became generally recognized as the principal authority on American Indian archæology. He was afterward chief editor of Frank Leslie's publications, and in 1871 was active in organizing the American Anthropological Society, of which he was the first president. A severe illness in 1874 incapacitated him for further research, though he recovered sufficiently to complete the revision of his work on Peru. His publications include ‹Ancient Monuments of the Mississippi Valley› (1848); ‹Aboriginal Monuments of the State of New York› (1851); ‹Serpent Symbols› (1852); ‹States of Central Peru› (1861); ‹Peru: Incidents and Explorations› (1877), etc.

SQUILL. See SCILLA.

SQUILLA. See CRUSTACEA; MANTIS-SHRIMP.

SQUINT, *in architecture,* an oblique opening passing through the walls of many old churches, usually constructed for the purpose of enabling a person in the transepts or aisles to see the elevation of the Host at the high altar. Generally they are not above a yard high and two feet wide, but sometimes they form narrow arches 10 or 12 feet in height.

SQUINTING. See Vision, Defects of.

SQUIRE. See Esquire.

SQUIRREL, a typical member of the rodent family *Sciuridæ*. The squirrels form the sub-family *Sciurinæ*, the members of which are of slender form and have long bushy tails. All squirrels have well-developed clavicles and the two bones of the lower leg well-developed and distinct; the premolar teeth are two above and one below, but the first upper one is small and usually deciduous; the molars, three in each jaw, broad, tuberculate and rooted; the incisor teeth are compressed and the palate broad. About 15 genera with very numerous species and sub-species are distributed throughout the world except in Australia. The typical species are diurnal and strictly arboreal, but some of the ground-dwelling species are transitional to the terrestrial and burrowing marmots (subfamily *Arctomyinæ*), and some are nocturnal. They are chiefly vegetarian, but differ much in the exact nature of their food; most of them partake more or less of an animal diet and many habitually rob the nests of birds of both eggs and young. In cold and temperate climates most species hibernate more or less completely and gather stores of nuts, grains and other foods for the winter months. Some species are known to migrate occasionally in large numbers. The species are of small or moderate size, the largest equaling a cat and the smallest a mouse. Squirrels are adaptable creatures and live under a great variety of climates and conditions, the two principal centres of development being regions physically so different as the Malayan Islands and North America, in the latter of which five genera and 120 species occur. The typical genus *Sciurus* includes species mostly of proportionally large size with magnificent bushy tails, no cheek-pouches, the thumb rudimentary and without nail, and the first upper premolar absent or minute. Of the 75 species, approximately, of this genus, fully one-half are Oriental.

Few native American mammals are better known or more beloved than the gray squirrel (*S. carolinensis*), sometimes called the cat squirrel, and, in its melanistic phase, the black squirrel. It abounds in hardwood forests from Canada to Florida and westward to Minnesota, and in the lowlands as well as the mountainous districts. As might be expected from this wide range, it splits into a number of distinct races. This species reaches a length of about 20 inches, of which the tail is nearly one-half and more rounded and bushy than in any other species. The eye is large, full and bright, the ears erect and pointed, but not tufted, and the color rusty gray above, more or less brown along the back and paler below. In the parks and more open parts of even large cities, wherever suitable trees supply a home and a refuge from cats and dogs, the gray squirrel has become semi-domesticated.

Its active arboreal habits and sprightly appearance have done much to make the squirrel the admitted type of frolicsomeness and sport. The food consists of nuts, acorns, seeds, fruits, etc., and these animals evince economic and frugal habits, in that they accumulate during the autumn a store of provisions, which is deposited in the nooks and crannies of trees. The nest and dwelling-place consists of a spherical structure formed of intertwined twigs with attached leaves lined with leaves and bark and is generally placed in the fork of a bough, in an inaccessible situation in the top of a tall tree. Cavities in trees are similarly lined and serve as nurseries and shelters in which to hibernate. The squirrels exhibit a great attachment for their respective nests, one pair generally occupying the same tree and nest for a long period. From three to four young are produced at a birth, usually in June, the young remaining in the parent nest until the following spring. When engaged in eating, these animals grasp the nut or other food in their fore-paws, sitting meanwhile on their haunches and gnawing off, by aid of their powerful teeth, the hard outer coverings, and even peeling the kernel before eating it. The bushy tail of the squirrel, besides serving, when folded round the body, to retain the heat, assists through its outspread hairs in supporting the animal in its aerial leaps, a function subserved in other squirrels by special developments of the skin.

Before the deforestation of this country had destroyed so many of its natural haunts this species was extremely abundant and not only sometimes raided cultivated fields to the great loss of the farmer, but occasionally migrated in great numbers, even crossing large rivers like the Ohio. Squirrel shooting is a favorite pastime with many, and were it not for the destruction which it entails of such lovable and sprightly animals could be commended as one of the pleasantest of sports, the pursuit of which takes one into forests of noble old trees in the most exhilarating season of the year. It necessitates long cross-country walks without the assistance of a dog, and requires a quick eye and steady hand to bring down the alternately appearing and disappearing game as it leaps and bounds among the topmost branches or projects itself through space from tree to tree. The practice of the Kentucky pioneers of «barking» squirrels has been too often graphically described by Audubon and others to require more than a passing comment.

The fox squirrel (*S. rufiventer*), which now inhabits almost exclusively the pine forests of the Southern States, is a large species. The body is 14 inches in length and the tail 12. The color is usually a rusty gray or clay color, whitish below and tending on the tail to rufous, margined with black; the top of the head black and the nose and ears white. The colors are, however, exceedingly variable, ranging from gray to deep black. The tail, though large, is less bushy, flatter, and the hair coarser than in the gray squirrel. Some of the varieties of the fox-squirrel extend northward through the mountains to New York and westward to the Dakotas, but have been nearly exterminated in most places and none are quite so large as the typical southern race. In general the habits of the fox-squirrel differ little from those of the gray squirrel, but in the South at least it does not hibernate nor store food, which consists largely of fruits, green corn, etc. Because of its large size it is much sought for food by the natives.

Of all our squirrels the most abundant and best known in the northeastern United States is the red squirred or chickaree (*S. hudsonicus*) which, like the others, splits into several subspecies and with related western species occupies British America and the northern half of the United States. In the east the high mountains of North Carolina are the southern limit of its range. The body is eight and the rather thinly haired tail six inches long, the color bright rusty red above, yellowish gray to light gray on the sides and below. Of all the squirrels this species is the most active, noisy and mischievous, constantly tearing over the ground and through the trees, playing, quarreling and chattering with its fellows. In most places it continues active through the winter. They breed and sleep in warm, lined nests in hollow trees or in old nests of crows and other large birds roofed over with twigs, leaves, bark of grape vines, etc.; they also have burrows, used partly as retreats, partly as one of their numerous storehouses for food. Besides nuts, etc., red squirrels feed largely on the seeds of spruce and hemlock, which they extract from the cones with great skill, and they are inveterate robbers of birds' nests, as well as of the farmers' corn-cribs. A remarkable fact is that, though so much inferior in size, this species frequently expels the gray squirrel from certain areas and it is true almost everywhere in the New England and Middle States that it is increasing and the gray squirrel decreasing in numbers.

The ground squirrels (*Tamias* and *Eutamias*) are provided with a pair of large cheek pouches and a well-developed nail on the thumb. The skull is relatively light and narrow, the first upper premolar minute or absent, the tail small and little bushy and the colors striped. The species and races are numerous, all but one Eurasiatic species being North American. The eastern chipmunk (q.v.) or ground hackee (*T. striatus*) is abundant everywhere in open woods from New England to Georgia, a distinct variety replacing it farther north.

Spermophilus is a genus, represented by numerous species in western North America and one in northern Asia and Europe, transitional between the ground squirrels, which they closely resemble in appearance and habits and the marmots. In deed they are ordinarily called striped marmots and by some zoologists are placed in the family *Arctomyinæ*. All have large cheek pouches, well-developed upper premolars and usually short tails; but vary greatly in colors and their pattern. *S. tridecenlineatus* is marked with six light longitudinal stripes alternating with seven rows of white dots on a brown ground. It is an abundant species on the prairies as far east as Illinois and is often wrongfully called «gopher.»

Lastly come the flying squirrels, the American species of which belong to the genus *Sciuropterus*. In the absence of cheek-pouches and some other features of their organization these remarkable animals more closely resemble the typical squirrels than the ground-squirrels, but depart widely from these and all other North American mammals in the possession of a densely hairy fold of skin extending along the sides and connecting the fore and hind legs, forming a parachute which, when extended, supports the animal on its flying leaps from tree to tree. The tail also assists in this function, the dense fine fur spreading at the sides like the vane of a feather. The common species (*S. volans*) is found throughout the eastern half of the United States north to Maine, where it is replaced by a distinct species. See FLYING SQUIRREL.

The squirrels of Europe in general resemble ours, but are less numerous. The common British squirrel, pictures of which are so common, is distinguished by its tufted ears; but our gray squirrel is becoming acclimated in England and is said to be driving away from its haunts the smaller native. Many of the African, and especially those of Borneo and neighboring islands, are remarkable for their large size, conspicuously striped fur, tufted ears or other peculiarities.

Consult Allen, 'Bull. Geol. Geog. Sur. Territories,' Vol. IV (Washington 1878); Allen, 'North American Arboreal Squirrels,' 'American Naturalist' (1899); Bailey, 'Prairie Ground Squirrels,' Bull. Biological Soc. of Washington (1893); Stone and Cram, 'American Animals' (New York 1900).

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SQUIRREL-CORN, or TURKEY-CORN, a delicate, succulent plant (*Bicuculla canadensis*), found in rich woods in North America. It has much dissected leaves, glaucous beneath, rising from the ground and simple scapes from which depend the peculiar, cordate-ovate corollas in racemes, each flower with four petals, the two outer oblong and concave, with short-rounded spurs at the base and parted at the other end to show the much-crested coherent tips of the other two. They are greenish-white tinged with rose-color and are fragrant. The perennial rootstock is creeping and bears many small yellowish tubers, scarred by fallen petioles, which have suggested the common names and also that of turkey-corn.

SQUIRREL HAKE. See HAKES.

SQUIRREL-MONKEY, a small American monkey of the genus *Chrysothrix*. These are active, tree-hunting, gentle little creatures, with long, rather bushy and squirrel-like tails and tufted ears and are lively and affectionate as pets. A widely familiar species is the Brazilian (*C. sciurea*), which is grizzled gray, with whitish paws and the tail black at the tip.

SQUIRREL-TAIL GRASS. See GRASSES IN THE UNITED STATES.

SRI, PADMA, or LAKSHMĪ, a female Hindu deity, wife of Vishnu. See LAKSHMI.

SRINAGAR, srĭ-nạ-gär′, or **SERINAGUR**, sĕr″ĭ-nạ-goor′ (signifying «Holy City»), capital of Cashmere, or Kashmir (q.v.), in northern India, in the beautiful valley of the same name, on the Jehlam River, occupies a lofty position, about 5,000 feet above sea-level. It extends about two miles along the river, which, with its windings and the numerous vessels plying upon it, has a very picturesque appearance, but the surrounding low marshes make the climate unhealthful. Near by is the famous Nana Khana Mountain, 23,497 feet in height. It is poorly fortified, although commanding a site which permits of making it a great stronghold. Its wooden buildings have been often destroyed by fire and few of them deserve notice. The Jama Musjid, or Great Mosque, celebrated mostly for its enormous dimensions, has a rude dome and spire; another mosque of wood is curiously Chinese in character. There are numerous gardens and a beautiful lake east of the town marks the scene of Moore's 'Lalla Rookh.' Srinagar manufactures attar of roses, shawls, leather, paper, firearms etc. It came under the British protectorate in 1846. Pop. about 126,344.

STAAL DE LAUNAY, stäl dā lō-nā, **Marguerite Jeanne Cordier,** BARONESS DE, French author: b. Paris, 30 Aug. 1684; d. there, 16 June 1750. She was the daughter of a poor painter named Cordier, was brought up at the convent of Saint Louis at Rouen and adopted her mother's name, De Launay. In 1711 she entered the service of the Duchess du Maine as *femme de chambre*. Not long afterward she became amanuensis and companion to the duchess and remained in her household for many years. In 1718 she was implicated in the Cellamare conspiracy and was sent to the Bastile for two years. In 1735 she was married to Baron de Staal. Her 'Mémoires' appeared in 1755 and it is as the author of those frank and lively pictures of the humors of the «court of Sceaux» that she is known to posterity, though she wrote also two comedies and some letters, which latter were published in 1806. Consult Sainte Beuve, 'Portraits Littéraires.'

STABAT MATER, stä'băt mä'tėr («The Mother stood»), first words and title of a celebrated hymn on the Crucifixion; its authorship is assigned to Jacopone da Todi, a disciple of Saint Francis de Assisi, in the 13th century. It has been set to music by several of the great composers including Palestrina, Pergolesi, Haydn, Rossini and Dvorak. The composition of Pergolesi, for two voices with accompaniment, is the most celebrated, but that of Rossini is the most popular in the concert room. The hymn as given in the 'Breviarium Romanum' office of the festival of the Seven Dolors of the Blessed Virgin Mary (Friday after Passion Sunday) begins:

" Stabat mater dolorosa,
Juxta crucem lacrymosa,
Dum pendebat filius."

STABILLITE, a smokeless powder, invented by Hudson Maxim, possessing the great advantage that no volatile matter is employed in its manufacture and consequently it requires no drying after manufacture, but is ready for immediate use. It was named because it is believed that it undergoes no change by keeping for a great length of time.

STACHYS, stā'kĭs, a genus of perennial and annual herbs and a few shrubs of the order *Labiatæ*. The species, of which there are about 150, are mostly natives of mild climates; a number flourish in the United States. They have simple, opposite leaves, small, white, yellowish, red or purple flowers in auxillary whorls or terminal spikes. They are mostly found in low, moist ground, but though several are attractive when in flower they are little cultivated.

STADIUM, a Greek measure of 125 paces, or 625 Roman feet, equal to 606 feet 9 inches English; consequently the Greek stadium was somewhat less than our furlong. It was the principal Greek measure of length. This term was also applied to the course for foot-races at Olympia in Greece, which was exactly a stadium in length. The name was also given to all other places throughout Greece wherever games were celebrated and the name is extended in modern use to cover buildings and equipment for a college racecourse or athletic-field.

STADTHOLDER, stăt'hōl''dėr, a title given in the Netherlands to a governor of a province who was also commander-in-chief of the forces. This title received its special significance in 1580 when the provinces of Holland and Zealand revolted against the authority of Spain and unitedly accepted William, Prince of Orange, as their stadtholder. The prince was assassinated before he was formally invested with this office, but the title was conferred on his son, Prince Maurice, and remained as the hereditary title of the chief of the state until Holland was annexed by France in 1802. This title was finally dropped in 1814 when the Prince of Orange was recalled from England and declared king of the Netherlands by an assembly of notables.

STAËL, Madame de, properly **STAËL-HOLSTEIN,** stä'ĕl-hŏl'stīn (Fr. stäĕl ŏl-stăṅ), **Anne Louise Germaine Necker,** BARONESS DE, French authoress: b. Paris, 22 April 1766; d. there, 14 July 1817. She was the only child of Jacques Necker, Swiss banker and Minister of Finance to Louis XVI. Her mother was Swiss (see NECKER, SUSANNE C. DE NASSE). Necker's house was the resort of the most distinguished men of the capital; every week on a certain day were assembled in the *salon* of Madame Necker the most eminent scholars of the day, as Marmontel, Raynal, Grimm, Thomas, etc. The encouragement the young girl received in this society and the various excitements which it furnished to her faculties, had an important influence on the formation of her mind. To these she owed that rare conversational power for which she was so remarkable, with that inclination to ingenious, brilliant and striking theories, which appear in her earlier works. Her earliest productions were 'Sophia,' a comedy (1786), and two tragedies, 'Lady Jane Grey' and 'Montmorency.' Her 'Lettres sur les Ouvrages et le Caractère de J. J. Rousseau' (1788), first attracted the public notice. In 1786 she was married to Baron de Staël-Holstein, Swedish Ambassador at the French court, a man much older than herself, whose suit was favored by Madame Necker's desire that her daughter should marry a Protestant.

The breaking out of the Revolution (1789) exercised a powerful influence both on her mind and fate. The first period of her father's service in the ministry (1777–81) brought his family into connection with the great world and public affairs. During Robespierre's ascendency she exerted herself to save the victims and published a powerful and eloquent 'Defense of the Queen.' After the insurrection of 10 Aug. 1792 she fled in September to her father's house at Coppet in Switzerland, which now became the refuge of the French fugitives. When

Sweden recognized the French republic, her husband was again sent as Ambassador to Paris, whither she returned in 1795. The government of the Directory gave her an opportunity of effecting the recall of some of the emigrants. Barras became her friend, and she acquired so much influence that, on Talleyrand's return from America in 1796, she obtained, through Barras, his appointment to the Ministry of Foreign Affairs. To this period also belong two political pamphlets, ‹Sur la Paix› and ‹Sur la Paix intérieure,› which contain her views respecting the situation of France in 1795 and express the remarkable opinion that France could arrive at limited monarchy only through military despotism. In 1796 appeared her ‹De l'Influence des Passions sur le Bonheur des Individus et des Nations,› which, though characterized by enlightened views, does not contain any complete exposition of the subject. Her connection with her husband, who died in 1802, whose tastes were different and whose talents were inferior to hers, had been from the first marked by coldness, and when she became desirous of securing the property of their children from the effects of his lavish habits, a separation took place; but his infirmities rendering the service of his friends necessary to him, she again joined him. Bonaparte she saw for the first time in 1797, on his return to Paris, after the Peace of Campo-Formio. His brilliant reputation excited her admiration, but this soon gave way to fear and aversion. The danger which threatened Switzerland led her back to Coppet; but when Geneva was incorporated with France she hastened back to Paris, to cause her father's name to be struck from the list of emigrants. But some observations of Necker in his ‹Dernières Vues de Politique et des Finances› (1802) offended the first consul, who caused the work to be attacked in the journals.

Madame de Staël was banished to a distance of 40 leagues from Paris, under pretense that she had given her father false information of the state of France. During her banishment she lived with her father at Coppet, but spent much time in traveling. Her literary reputation was meanwhile increased by her ‹De la Littérature considérée dans ses Rapports avec les Institutions sociales› (1802) and her ‹Delphine› (1802). The former attracted many assailants, among whom Fontanes was the ablest and acutest. Her romance ‹Delphine› contained a faithful picture of herself as she was in her youth — separated from the multitude by genius and sensibility and struggling against the restraints of custom and her sex. In 1803 she made a visit to Germany and lived for about a year in Weimar and Berlin. She paid a visit to Italy in 1805 and the fruit of her journey was ‹Corinne ou l'Italie› (1807), which combines in a happy manner the charms of romance with a faithful picture of Italy. It was finished in France and was no sooner published than she was ordered to quit that country, upon which she returned to Coppet. Here she wrote ‹Essais dramatiques› and finished (1809) her work on Germany (‹De l'Allemagne›). She then went to France to get it printed, but before it could be published the printed copies were seized by the police and she was again ordered to quit France. It first appeared entire in London in 1813. This work gave the French the first intimation of the intellectual development of Germany.

Returning to Coppet from France, Madame de Staël was subjected to new persecutions and was forbidden to go farther from her residence than two leagues. But in the spring of 1812 she escaped and passing through Vienna to Moscow, on the approach of the French army went to Saint Petersburg and soon after, in the autumn of 1812, to Stockholm. From Stockholm she went to England, where she was received with the most flattering attention. Here was published her ‹Réflexions sur le Suicide› and ‹Zulma et trois Nouvelles.› After a long exile, described in her ‹Dix Années d'Exil,› she landed at Calais in 1814. After the Restoration in 1815 she returned to Paris and was received with great distinction. She also received from the government public stock to the amount of 2,000,000 francs, due to her father by the treasury at the time of his dismissal from office. Surrounded by a happy domestic circle, esteemed and courted by the most eminent men of the capital, she lived in Paris, with the exception of a short absence, till her death, and until her last sickness she was employed on her ‹Mémoires et Considérations sur les principaux Evénements de la Révolution Française› (1819). By her will it was made known that in 1812 she had been married a second time to a M. de Rocca, a young officer of hussars, who, suffering from wounds received in Spain, had quitted the service and come to reside at Geneva, where she became acquainted with him. See CORINNE.

Consult ‹Life› by Norris (1853); d'Haussonville, ‹Le Salon de Madame Necker› (1882); Lady Blennerhasset, ‹Frau von Staël› (1888–89); Brunetière, ‹Evolution de la Critique› (1890); Schück, ‹History of a Marriage in Letters› (1906); Sorel, ‹Madame de Staël› (1890); Faguet, ‹Politiques et Moralistes› (Vol. I, 1898). Her son edited her works (17 vols.) in 1820–21. Her ‹Lettres Inédits› appeared in 1903.

STAFF, in the army or navy, a body of officers or non-commissioned officers whose duties refer to a body of troops or a fleet as a whole and who are not attached to particular subdivisions. Such officers are called staff officers, while those in command of combatant organizations are line officers. The staff of the army includes the officers of the quartermaster-general's, adjutant-general's, ordnance, medical, engineer (in part), judge-advocate-general's and inspector-general's departments; officers attached to commanding general officers as military secretaries and aides-de-camp, called the personal staff; officers employed in connection with the civil departments at the War Department, chaplains, veterinarians, medical officers of combatant organizations, intelligence officers, etc., and those engaged in recruiting and garrison work, and the general staff of the United States army. See ARMY SCHOOLS; GENERAL STAFF CORPS.

STAFF, in music, the five parallel lines and their intermediate spaces on which the notes, sharps, flats and other musical characters are placed. See MUSIC.

STAFF COLLEGES AND SCHOOLS, military institutions for the advanced instruction of officers desirous of being placed on the staff of the army. See Army Schools.

STAFF CORPS. See Army Staffs.

STAFFA, stăf'ạ, Scotland, a small island of the inner Hebrides, situated seven miles west of Mull. It is celebrated for its basaltic pillars and natural caves, the most noted of which is Fingal's Cave. The island, which is one-half mile in diameter, consists of columnar basalt capped by a shapeless mass. This gives the interior of the caves almost architectural forms. Fingal's Cave extends 227 feet inward and the opening is an arch 66 feet high. The floor is covered with from 9 to 18 feet of water.

STAFFORD, stăf'ŏrd, **Henry,** duke of Buckingham. See Buckingham, Dukes of.

STAFFORD, William Howard, Viscount, an English statesman; b. 30 Nov. 1614; executed on Tower Hill, 29 Dec. 1680. He was the son of the 20th earl of Arundel, the well-known collector of the Arundelian marbles. In November 1640 he was created Viscount Stafford. He was brought up in the Roman Catholic faith and adhered during the civil wars to the royal cause; but after the Restoration he was frequently found in opposition to the court, although he appears never to have played an important part as a legislator. He was singled out by Titus Oates, the contriver of the «popish plot,» as one of his chief victims. On 23 Oct 1678 Oates deposed before the House of Commons that upon the subversion of the kingdom by the Jesuits, Lord Stafford was to have the appointment of paymaster of the army, and on the 30th the accused nobleman was committed to the Tower, with other Catholic peers against whom similar charges had been preferred. After lying two years in prison, he was brought to trial on a charge of high treason 29 Nov. 1680. During a trial of seven days he defended himself by pointing out the weakness of Oates' evidence, so that Evelyn, who was present, thought «such a man's testimony should not be taken against the life of a dog.» Nevertheless a verdict of guilty was pronounced by a vote of 55 to 31. He was executed three weeks afterward.

STAFFORD, England, capital of Staffordshire, on the river Sow, 18 miles south of Hanley and 25 miles north by west of Birmingham. The principal buildings include the church of Saint Mary's, which has fine stained glass windows and many interesting monuments; Saint Chads, a fine old Norman church; a stately county hall; a borough hall, containing a museum, and the market hall; hospital, asylum, a Latin school (1550), technical schools and a theatre. The town has extensive tanneries, leather manufactories, and engineering and electrical works. In the neighborhood is Stafford Castle. Many ancient buildings like High House attest to the antiquity of the town. Pop. 23,400.

STAFFORD SPRINGS, Conn., borough in Tolland County, on the Willimantic River and on the Central Vermont Railroad, about 18 miles southeast of Springfield (Mass.) and 18 miles northwest of Willimantic. It is in an agricultural and a manufacturing section of the State. The chief manufacturing establishments are woolen mills, iron works, machine shops, flour-mill, creameries and tobacco works. There are Protestant Episcopal, Roman Catholic, Congregational and Methodist Episcopal churches. The educational institutions are a public library, founded in 1874, a high school and public and parish schools. There are two banks. Stafford Springs is a favorite resort for health seekers on account of the mineral springs. Pop. 3,000.

STAFFORDSHIRE, stăf'ŏrd-shĭr, England, a midland county, with an area of 1,128 square miles. The Moorlands is a hilly district at the north, intersected by deep valleys. The surface is mostly undulating. The Trent is the chief river and its tributaries are the Sow, Tame, Blythe and Dove. Few valleys are fertile in the central portion. In the south are important iron and coal deposits. The Dudley and Pottery coalfields contain several hundred collieries and produce large quantities of ironstone. Important copper-pits are found near Warslow, while on the banks of the Dove at the north, colored marble, alabaster, mill-stones and chalk are found. The clay for pottery which makes the Wedgewood ware famous is taken from the «Potteries» district of North Staffordshire, where extensive china and pottery factories exist. The manufacture of various metals is extensive, also leather, silk, wool, linen and sailcloth. The important towns are Stoke-upon-Trent, Burton, Wolverhampton, Wallsall, Handsworth and Smethwick. Pop. 739,000.

STAG. See Deer.

STAG-BEETLE, a beetle of the family *Lucanidæ,* in which the jaws of the males are greatly enlarged and studded with spike-like protuberances which give them a resemblance to stag antlers. The mandibles of the females are short, of smaller size, and curved, and the club or terminal part of the feelers is four-jointed. These beetles are vegetable feeders and subsist upon the tender leaves and other parts of plants. The larvæ are found in trees, into the substance of which they burrow.

STAGE, The. See Theatre.

STAGE, The American. See Theatre.

STAGE COACH. See Coach; Omnibus.

STAGE MECHANICS. See Theatre.

STAGGER-BUSH, an ericaceous shrub (*Neopieris mariana*) found south of Rhode Island in moist, sandy soil, chiefly along the Atlantic Coast. It has a bad reputation for poisoning livestock which may feed on its foliage and giving them the disease known as «staggers.» It is a low shrub, rarely four feet high, with erect, wand-shaped, black-dotted branches, bearing alternate, oval leaves, which are shining and leathery and turn to an intense scarlet before falling in the autumn. The flowers are borne in axillary embels, on the under side of the naked year-old branches and are large, white, waxen urns, with five little teeth about the orifice. They bloom in early summer and the shrub is one of the handsomest of its kind.

STAGGERS, one of several varieties of disease in domestic animals, as blind-staggers in horses and cattle, an epileptic disorder primarily affecting the brain and spinal cord. A form of digestive derangement to which horses are especially liable is a kind of gastritis called stomach-staggers. This is a dangerous disease as yet little understood. In the stable the horse dozes and rests his head in the manger; he then wakes up and eats until the distention of the stomach becomes enormous. The peculiarity of the complaint consists in the total stoppage of digestion and the uneasy feeling of distention, consequent to such indigestion, appears to deceive the horse, whose morbid excitement induces him to continue eating. This he does until the distention prevents the return of the blood from the head and the animal dies from apoplexy, or his stomach bursts. Recovery is rare, except in very mild cases. Grass-staggers is a disorder caused in horses and cattle by eating the loco-weed or crazy-weed (q.v.). It is also known as the loco-disease. In sheep a peculiar kind of staggers occurs which is called gid. See Sheep.

STAGHOUND. See Dog.

STAHL, stäl, **Georg Ernst,** German physician and chemist: b. Anspach, 1660; d. Berlin, 1734. He studied medicine at Jena and in 1691 was chosen second professor of medicine at Halle and rendered his name famous over all Germany by his academical prelections and his publications. In 1700 he was elected member of the Academia Curiosorum Naturæ. His fame procured him the appointment of physician to the king of Prussia in 1716 and he went to Berlin. He was the author of the doctrine which explains the principal chemical phenomena by the agency of phlogiston. This theory was received and supported by some of the most eminent men which Europe had produced. His principal works are ‹Experimenta et Observationes Chymicæ et Physicæ› (1731); ‹Disputationes Medicæ›; ‹Theoria Medica Vera› (1737), and ‹Fundamenta Chymicæ Dogmaticæ et Experimentalis.›

STAHLBERG, stäl'bĕrk, **Kaarlo Juho,** Finnish statesman: b. 1865. For several years he was the leader of the Finnish National Progressive party in the Diet and in 1914 was elected speaker. Dr. Stahlberg's advocacy of democratic principles brought him under the ban of the old Russian Imperialist régime and at one time he was ordered to be expelled from the Diet by the Russian governor-general. He served as president of the highest administrative court in Finland and also as professor of law in the University of Helsingfors. In July 1919 Dr. Stahlberg was elected president of the new republic of Finland, receiving 143 votes in the Diet against 50 votes cast for Gen. Justus Mannerheim, who had been acting as regent. Dr. Stahlberg has traveled extensively and is well known in European university circles.

STAHR, stär, **John Summers,** American college president: b. Bucks County, Pa., 2 Dec. 1841; d. 21 Dec. 1915. He was graduated from Franklin and Marshall College, 1867, and at once entered the faculty of that institution, successively being tutor in German and history, assistant professor, professor of natural science and chemistry, financial agent, president pro tem. and since 1890 president of the college. He studied theology, was ordained in 1872 and at one time supplied the pulpit of the First Reformed Church, Reading, Pa. He was a consulting member of the editorial staff of the ‹Standard Dictionary.›

STAIGG, stāg, **Richard M.,** American painter: b. Leeds, England, 1820; d. 1881. He emigrated to the United States in his 11th year and in early manhood attained consummate skill in painting miniature portraits on ivory. In 1861 he was elected National Academician, and after studying in Paris (1867–69) he abandoned miniature painting for landscape and portraiture in oils. His marines are admirable for color and detail and among his best genres are the ‹Sailor's Grave› (Lenox Library) and the ‹Cat's Cradle.›

STAINED GLASS. See Glass Staining and Glass Painting.

STAINER, stī'nĕr, **Jakob,** German violin-maker: b. Absam, 14 July 1621; d. 1683. He was apprenticed to a maker of stringed musical instruments at Innsbruck. He learned the secret of the Italian method of constructing violins and won a reputation that passed beyond Germany into Italy and England and lasted for more than a century.

STAINER, stā'nėr, Sir **John,** English organist and composer: b. London, 6 June 1840; d. Verona, Italy, 1 April 1901. At seven he became a chorister in Saint Paul's Cathedral; in 1856 Sir Frederick Ouseley appointed him organist of the newly-founded Saint Michael's College at Tenbury, and four years later he became organist of Magdalen College, Oxford. From 1863 till 1872 he was university organist, and from the latter year until his resignation in 1888 held the post of organist in Saint Paul's, London. In this position he achieved great success and contributed much to the improvement of the musical part of the service in the cathedral. In 1881 he succeeded Sir Arthur Sullivan in the principalship of the National Training School, and in 1882 became inspector of music in the elementary schools of England. He was professor of music in the University of Oxford from 1889 till his resignation in 1899. He was knighted in 1888. He was a composer of considerable ability, his principal compositions being cantatas entitled ‹The Daughter of Jairus› (1878); ‹Saint Mary Magdalen› (1883), and ‹The Crucifixion› (1887), and many anthems, organ pieces, etc. He published various musical primers, a ‹Dictionary of Musical Terms› (with W. A. Barrett), and a valuable work on 15th century music entitled ‹Early Bodleian Music: Dufay and his Contemporaries.›

STAINES, stānz, England, a town in Middlesex, on the Thames, six miles southeast of Windsor. Runnimede, Egham and Cooper's Hill are interesting suburbs. Inigo Jones and Rennie, two of England's greatest architects, are remembered by the church of Saint Mary's (1631), and the bridge across the river (1832), respectively their works. The Roman Catholic Gothic church dates from 1868. The industrial works include breweries and mustard mills. The garden-markets and race-course are interesting features. Pop. 6,688.

STAIR, Lord. See Dalrymple.

STAIR, a succession of steps affording means for a person on foot to get from a lower to a higher level. There are two main forms of this, one composed of a series of solid blocks generally touching one another at one edge, as when a series of squared stones are built into a wall at either end, their small surface of junction merely steadying them; and the more common sort, in which two sloping beams, planks or metal girders, called string pieces or strings, support a series of horizontal planks, slabs of marble or slate, or plates of metal called treads. The above are the essentials of a stair. The riser which stands for the vertical distance from one tread to another may be left open, or may be filled by a light board, a piece of open-work cast iron or the like. In the case of a stone step the tread is the uppermost surface and the riser the front — the surface turned toward the person who is ascending.

There is a marked distinction between the straight and the winding stair. In a straight stair all the steps are called fliers and the tread of each is of the same width from end to end. In the winding stair the steps are called winders and the treads are much narrower at one end than at the other. The typical winding stair is the spiral or corkscrew stair (in French called *à colimaçon,* snail-like). These are commonly built into round towers, the walls of which support the steps, but it is feasible to build them of wood or iron, and in modern libraries and other places of storage, very light spiral stairs are built for easy access to balconies, galleries and upper floors, as in the stack-room for books or other place of deposit or storage.

A stair may be made up of several short stairs called usually flights. Thus in the case of a rather lofty story, there may be one or even two landings in the height from floor to floor, and, therefore, two or even three flights. If these landings give to the stair a change of direction of 90 degrees, so that a person ascending and going northward suddenly turns eastward or westward, the platform is called a quarter-pace (sometimes quarter-space). If the change of direction is of 180 degrees, the person ascending reversing his direction as from north to south, the word half-pace (half-space) is used. A combination of thes methods is also used, as where a platform is associated with some winders; the platform being then nothing but a tread much wider than the others. This is a very objectionable plan, as being dangerous for persons not acquainted with the stair.

The height of the riser and the width of the tread are matters of great importance. Rules exist for fixing these, and it is generally considered that the riser and tread must be taken together. Thus, if it be held that each tread-and-riser should measure 18 inches, then the riser may be 6½ inches high, the tread 11½ inches wide. This is often expressed by the formula, a riser 6½ inches, a run of 11½ inches, or by the phrase, the rise and run are to each other as 6½ to 11½. In modern buildings of no great cost or elegance the stairs are often very much steeper than this; and the proportions may even be reversed, or nearly so, in the case of a flight rarely used, as from the top floor to the roof.

The stair is often an architectural feature of some importance. In the interior a large hall is sometimes devoted to it, and the stair itself is a principal part of the decoration, perhaps passing along three sides of this hall, seeming to cling to the wall as it ascends, leaving below an open floor of considerable size which may be treated more or less as a sitting-room, and at the top communicating with a gallery. This gallery may be a highly architectural member, being treated with columns to support the roof. The objections to this treatment of a stair are the great amount of space occupied and the opening of so much of the interior to drafts of air and to ready communication of fire. It should only be used where the building is wholly fireproof. It leads to great expense in building the stair of marble, lining the walls with the same or an equally costly material and roofing the whole with an architectural dome or coved ceiling with or without a sky-light. The tendency in recent times is to use elevators in buildings of all kinds, public and private, and in consequence of this the stair seems to be considered sometimes a mere piece of utility and for that purpose made as compact as possible; while in another building not more costly and splendid it will be treated in the way described above. It is worthy of notice that any building in which it is expected to give stately entertainments, the stair-case, or hall, which encloses the stair, will be treated in a more stately way, and this because of a tradition that the persons of a large assemblage will seek the halls and stairs, perhaps for more space, perhaps for fresh air. Thus, in an opera house, the stair is a very important feature.

Out-of-door stairs are seen on city tenements and apartment houses as fire-escapes, but they do not often exist in connection with classical or neo-classical architecture. They have great picturesqueness of effect and are associated with mediæval architecture — both northern and southern — and with the rough wooden buildings of Switzerland and Tyrol.

The term stair is not often used to cover the broad flight of steps leading up to a portico, nor for the steps of a front door when they do not exceed 10 or 12 in number; nor yet for those in a terraced garden. For such out-of-door flights of steps the French term *perron* may be used and is perfectly descriptive of the thing; no correlative term exists in English except the local term used in New York City and vicinity: stoop.

RUSSELL STURGIS.

STALACTITE and STALAGMITE, deposits of lime hanging from the roof (stalactites) or rising from the floor (stalagmites) of a cavern. Stalactitic formations occur chiefly in long and more or less fantastic masses suspended from the roofs of caverns in limestone rocks. Stalactites appear to be continually forming; water containing carbonate of lime held in solution by carbonic acid, trickling through crevices in the roofs of the caverns, gradually during its exposure to the air loses its carbonic acid and consequently deposits its carbonate of lime; the water passing over the portion first deposited gradually adds to it, and eventually gives the carbonate of lime its great length and stalactitic character. The flatter deposits, called stalagmites, are formed on the floor of the cavern by the water there depositing that portion of its carbonate of lime which is not separated during the formation of the stalactite. They sometimes occur as cones rising to meet the stalactites in the form of large pillars, and sometimes form flat crusts over the bottoms or sides of a cave. Stalactitic carbonate of lime is met with in the veins of lead ore in Durham and Northumberland, England. Caverns are sometimes nearly filled with these deposits, which in some cases are of very large dimensions. Oriental alabaster (q.v.) and Mexican onyx are formed as stalagmitic crusts, and consist of calcium carbonate. Among striking examples of stalactites and stalagmites are those of the Luray and Mammoth caves (qq.v.) in the United States; those in the cavern at Castleton, Derbyshire, England, and in the Isle of Skye; in the grotto of Antiparos in the Grecian Archipelago; in the Woodman's Cave in the Harz, Germany; at Auxelle, France; and the most important of those at Adelsberg, Austria-Hungary. Stalactites of iron sulphide, marcasite, are also known. By oxidation of the sulphide, they may be altered to limonite, forming the so-called pipe ore of certain Missouri iron deposits.

STALEY, Cady, American civil engineer and educator: b. Minaville, N. Y., 12 Dec. 1840. He was graduated at Union College in 1865, and after a period as a gold prospector in the Rocky Mountains he was a civil engineer engaged in the construction of the Central Pacific Railroad. He became associated with the faculty of Union College in 1867, was appointed professor of civil engineering in 1868, and in 1876–86 he was dean of that institution. He was president of the Case School of Applied Science, Cincinnati, in 1886–1902. Author of ‹Strength of Materials and Stability of Structures› (1876); and joint author of ‹The Separate System of Sewage› (1882; 3d ed., 1899).

STALIMENE. See Lemnos.

STALKER, stâk'ẽr, **James,** Scottish Free Church clergyman: b. Crieff, 21 Feb. 1848. He was educated at the universities of Edinburgh, Halle and Berlin, and at New College, Edinburgh. He held pastorates at Kirkcaldy and Glasgow, 1874–87; delivered the Lyman Beecher lectures on preaching at Yale University, 1891; was Cunningham lecturer in 1899, and has been professor of church history in the United Free Church College, Aberdeen, since 1902. Among his many publications are ‹The Life of Jesus Christ,› ‹The Preacher and His Models,› ‹The Seven Cardinal Virtues,› ‹The Two Saint Johns,› ‹The Christology of Jesus,› ‹Life of St. Paul,› ‹Imago Christi,› ‹Trial and Death of Jesus,› ‹The Seven Deadly Sins,› ‹John Knox,› ‹How to read Shakespeare,› ‹Poets and Poetry of the Bible,› etc.

STALL, Sylvanus, American Lutheran clergyman and author: b. Elizaville, Columbia County, N. Y., 18 Oct. 1847; d. 6 Nov. 1915. He was graduated at Pennsylvania College, Gettysburg, 1872, and studied theology there and at the Union Theological Seminary in New York. He held Lutheran pastorates from 1874 to 1888, and was associate editor of the *Lutheran Observer* from 1890. He was for years statistical secretary of the general synod of the Lutheran Church and published ‹Stall's Lutheran Year Book and Historical Quarterly› (1884–88). His other publications include ‹How to Pay Church Debts› (1880); ‹What a Young Boy Ought to Know› (1897); and the three other volumes of the ‹Purity Series,› concluding with ‹What a Man of Forty-five Ought to Know› (1901).

STALL, a fixed seat in a church, intended for the accommodation of one of the choristers or of the clergy, and therefore usually in the choir. Much the most common arrangement is to have the stalls in rows on the two sides of the choir, the occupants of the stalls looking inward toward the axis of the church and therefore toward the altar or the space immediately behind or before it. Such a fixed seat forming one of a group will naturally be enclosed at the back and sides, and it is customary to have two rows of stalls, an outer one set immediately on the floor or with a few inches elevation in order that a wooden floor may be put above the stone floor of the church, and a second row behind, perhaps two steps higher. Where a row of stalls is very long there may be an opening or more openings than one in the front row, made by the omission of a seat, and intended for access to the back row.

As the occupant of a stall sometimes sits and sometimes stands for a length of time during the service, it is common to arrange a hinged seat easy to lift and to lower again, and made heavy so as to be firm. Such a seat is usually carved out of a solid mass of heavy wood, the boss underneath which gives it weight and balances it on the hinges, being often an elaborate representation of a cluster of leaves, a human figure or a group of several figures, or a monstrous animal. Such bosses are called misericords or sometimes misereres.

The most elaborate stalls known are those of the cathedral of Amiens, magnificent joinery and carving of about 1510.

Russell Sturgis.

STALLO, John Bernard, German-American jurist and scientist: b. in Grand Duchy of Oldenburg, Germany, March 1822; d. Florence, 5 Jan. 1900. He received a liberal education in Germany and came to America when 16. Was professor of Latin and Greek in Saint Xavier's College, Cincinnati; was also proficient in English, German, Dutch, French, Spanish, Italian and Hebrew. After two years at Saint Xavier's he was made professor of Latin in Saint John's College, New York, and while there studied law. He returned to Cincinnati in 1847 to practise law, and sat upon the Common Pleas bench of Hamilton County in the 50's. In 1885 Judge Stallo was appointed Minister to Italy by President Cleveland, but upon the election of Harrison he resigned and lived in Florence until his death. The last 15 or 20 years of his life were largely devoted to the study of philosophy. He published ‹General Principles of the Philosophy of Nature,› ‹The Concepts and Theories of Modern Physics,› and ‹Abhandlungen und Briefe.›

STALWARTS. See Republican Party.

STALYBRIDGE, stā'lĭ-brĭj, England, in the counties of Lancaster and Chester, about five miles east of Manchester, on the Tarne, stands in a barren district on slopes rising from both banks of the river. The public buildings include the town-hall, free library, several churches and post office. The manufacture of cotton goods is considerable, occupying many thousand hands. Besides, there are foundries, machine shop and millwright works. The importance of the town dates from 1776. Pop. 27,673.

STAMBOUL, stăm-bool'. See CONSTANTINOPLE.

STAMBULOFF, stăm-boo'lof, **Stephen Nikolof,** Bulgarian statesman: b. Tirnova, 1853; d. Sofia, 18 July 1895. He took part in the rising of 1875–76, and as an office-holder during the occupation by the Russians, following the War of 1878, became prominent as a leader of the radical party in the new national assembly. He was a conspicuous member of the regency which followed the abdication of Prince Alexander, strongly opposed to the adherents of the Russians, and when he became Premier in 1878, after the election of Ferdinand, ruled with scant regard for prince or legislature. He was forced to retire in 1894; his death the next year was the result of an attack by assassins.

STAMFORD, stăm'fŏrd, Conn., city in Fairfield County, on Long Island Sound and Mill River, and on the New York, New Haven and Hartford Railroad, about 22 miles southwest of Bridgeport and 30 miles northeast of New York. The harbor is large enough for large Sound vessels. The city has regular steamer connection with New York, and electric lines extend to all the nearby cities and towns. Stamford was settled in 1641 by a colony from New Haven. An Indian village named Rippowam had existed here, but the name was changed in 1642. It was incorporated as a borough in 1830, and in 1894 was chartered as a city. The surrounding country is devoted mainly to agriculture, but the city has large manufacturing interests, and is the commercial centre of an extensive region. The chief establishment is the Yale and Towne Manufacturing Company, which regularly employs about 2,500 persons. Other manufactures are extracts, typewriting machines, woolen goods, lumber, hats, shoes, machine shop products, pottery, dyestuffs, patent medicines, chemicals, hardware and wagons and carriages. The government census of 1910 gives the number of manufacturing establishments as 86; the amount of capital invested, $11,926,000; the cost of material used annually, $3,704,000; and the value of the product, $8,740,000. There are a number of small parks in different parts of the city; three in the residential section. The water supply comes from Trinity Lake in New York State. There is an excellent sewerage system and a paid fire department. There are a large city hospital, Saint John's Hospital and Home, and several private sanatoriums. The educational institutions are a high school (new building erected in 1895), the diplomas from which entitle the holders to entrance to several universities and colleges; nine large elementary schools, one large parish school, the Catherine Aiken School for girls, the Betts Academy, founded in 1838, for boys; Misses Low and Heywood School, the King School and the Manor School at Shippan Point. The Ferguson Library is housed in a fine building. The banks have a combined capital of approximately $1,000,000. The government as at present constituted is administered under a charter which provides for a mayor and a common council, elected biennially in even years. Appropriations are in charge of a board of appropriation. The population of the city in 1910 was 25,138, but the town of Stamford has 28,836 inhabitants. The 1917 estimate is 32,000 for the city and 36,000 for the town.

STAMFORD, England, in the counties of Lincoln and Northampton, on the Welland, 12 miles northwest of Petersborough. The main buildings are Saint Mary's Church (13th century), All Saints, Saint Martin's, Saint John the Baptist's (15th century), town-hall, corn exchange, assembly and club rooms, literary institute, Browne's hospital (15th century), school and charitable institutions. The manufacture of agricultural implements and breweries are the chief sources of industry and trade. Pop. 8,229.

STAMMERING, a defect of speech due to failure in co-ordinate action of certain muscles and their appropriate nerves. It is analogous to some kinds of lameness, to cramp or spasm, or partial paralysis of the arms, wrists, hands and fingers, such as is sometimes attendant upon certain exercises; for speech is a muscular act involving the co-ordinate action of many nerves and muscles.

The words stammering and stuttering practically denote the same infirmity, although stuttering is now limited more or less to the futile repetition of sounds, while stammering covers the whole defect — hesitation, glide, stop, holding on to the sound, as well as repeating it. Because stammering is proved to be pretty widespread in Prussia, Great Britain and its colonies, and the United States, and uncommon in Italy and Spain, the question suggests itself whether languages of Teutonic origin are not more apt to generate it than languages of Latin origin. This chief of the imperfections of speech may be hereditary, and it may be acquired by imitation. Like yawning, it is infectious. It may be the abiding result of mental strain or shock. Fever may bring it on, epilepsy, hysteria, or any serious nervous affection or strong emotion, temporary failure of health, any excitement, or even soreness of the mouth. It rarely shows itself earlier than at four or five years of age. It usually begins in youth, but may be produced at any later age. A much larger proportion of males than of females stammer. Stammering used to be ascribed exclusively to the organ of articulation, the mouth; to faulty setting of the teeth or the jaws, to the largeness and thickness of the tongue, its weakness of movement, its excessive vigor, etc. At present in the research for the cause and cure of stammering full account is taken of the vocal cords or cushions and the vocal chink.

Stammering occurs in the mouth, the organ of articulation. Its proximate cause is always in the larynx, the organ of voice. Sometimes the lungs, the organ of breathing, complicate the uncertainty and unsteadiness of the vocal cords and the vocal chink in the larynx. A current of air, variously shaped by the mouth as a whole, is what is called a vowel. A stammer on a vowel can only take place in the vocal chink, rima glottidis. The sounds called consonants are produced by closures, more or less firm, of contents of the mouth. Thus, *b, p, m, w,* by the closure of the two lips; *f, v,* of the lower lip and upper teeth; *g* soft and *sh,* of the teeth; *l* and *th,* tongue and upper teeth; *t, d, n,* *s, z, y,* tip of the tongue and fore gum; *g* hard and *k* back edges of the tongue and back gum. Stammering may occur at any of these six closures. It is, perhaps, most apt to occur at the labials *b, p,* the dentals *d, t,* the gutturals *g* hard, *k,* because for these the closure is firmest. The stammerer has no difficulty in setting lips, teeth, tongue and gums against each other as required. His difficulty is to relieve the closure, to get at the vowel which is to follow the consonant. The tongue, for example, will not part with the teeth — seems to cling spasmodically to them — because the current of air, the vowel, does not come at the proper instant through the vocal chink to relieve it. In this way the three observable modes of stammering are explained. If the vocal chink does not open soon enough there is a stop stammer; if it flutters, there is a stutter; if it opens too soon, there is a glide stammer. But, further, the lungs expand and contract by nervous and muscular energy; and, besides, the muscular and nervous machinery of the breastbone, ribs, midriff and upper abdomen are all concerned in that expansion and contraction. These complicated and delicate bellows which supply air under pressure to the organ of voice may be defective, out of order, misused. Their working is to be closely observed in the case of each stammer. Stammerers, as a rule, breathe badly. They constantly try to speak when their lungs are empty.

Stammering can be cured. It often disappears gradually without special effort at cure, through an improvement in the general health and especially of the nervous system. Improvement generally takes place as age advances. In some cases resolute endeavor is demanded. A waving motion of the arms, time kept to a baton were favored as cures at one time. They were on the lines of the musical methods of cure — intoning, chanting, singing — which were based on the fact that most stammerers can sing without difficulty. The stammerer should be taught to regulate the breath, and he should work for a habitual use of the chest voice — for deeper, steadier vibration of the vocal chords — since stammering usually occurs with use of a head voice. The stammerer should take exercise in a chest voice, on the sounds (seldom vowels) at which a stumble is apt to be made.

STAMP ACT, an act for regulating the stamp duties to be imposed on various documents. In 1765 George Grenville, chancellor of the English exchequer, proposed a bill for taxing the colonies through a stamp duty. No serious opposition was expected. But the measure aroused great excitement in America as an attempt at taxation without representation. In the United States, a Stamp Act congress consisting of delegates from all the colonies except New Hampshire, Virginia, North Carolina and Georgia, met at New York 7 Oct. 1765, and adjourned 25 October. The action of this congress consisted of an address to the king, petitions to Parliament and a declaration of the rights and grievances of the colonies. It protested that the colonies could only be taxed by their own representatives in the colonial assemblies; claimed the inherent right of trial by jury, and declared the Stamp Act to have a manifest tendency to subvert the rights and liberties of the colonies.

STAMP COLLECTING. See Philately.

STAMP-DUTY. See Duty; Taxation.

STAMP-MILL, a crushing mill or machine for pulverizing ores and rocks. In Western mining camps the stamp-mill is usually worked by water power. See Mining.

STAMPING OF METALS. See Dies and Die Making.

STAMPS, Postage. The boldness of conception in suggesting a penny (two cents) postage for Great Britain for letters of half an ounce showed a broadness of mind well worthy the title of «Sir» it brought later on Mr. Rowland Hill. Railroads, it is true, were making travel both easier, cheaper and more rapid, but they were few and postal delivery through all the United Kingdom still meant transportation largely by coach and frequently over roads that were bogged in wet weather (and England, then as now, had a rainy climate). Rates for single letters at that time were as follows for delivery in England or Wales from any post office to any place:

Not exceeding 15 miles from such office	4	pence.
Between 15 and 20 miles	5	“
Between 20 and 30 miles	6	“
Between 30 and 50 miles	7	“
Between 50 and 80 miles	8	“
Between 80 and 120 miles	9	“
Between 120 and 170 miles	10	“
Between 170 and 230 miles	11	“
Between 230 and 300 miles	12	“

Added to this was another penny on each single letter for every 100 miles over 300, also one penny for postage and sometimes «toll-fees.» A letter from Kirkwall to Southampton called for an expenditure of one shilling and six pence; to London nine pence plus another penny for postage; to Cork, Ireland, cost one shilling and three pence. These sums were for a single sheet of paper, two sheets costing double. Under such conditions came Hill's Uniform Penny Postage plan. The system of franking suggested did away with the great cost of «collection» and frequent loss on refusal of payment on the part of the addressee. The cost of production and sales of penny stamps was comparatively infinitesimal, and this fact, of course, permitted its success, also the enormous growth numerically of the patronage. Before the introduction of the reform the post office handled (in 1839) 75,907,572 letters; letters for the following years were:

1840	168,768,344	1880	1,176,423,600
1850	347,069,071	1890	1,705,800,000
1860	564,002,000	1900	2,323,600,000
1870	862,722,000	1910	2,947,100,000

The term «postage-stamp» is, of course, something of a misnomer that has crept into the English language. It is no *stamp*. What we call the «post mark» is a *stamp*. When the adhesive «stamp» was first introduced it was known as a «label,» and to the philatelist it remains a «label» to this day. As a discussion of a subject presupposes some knowledge of the terms used by the expert it would be well to explain some of the terms used by the philatelist. We will quote a few in part from Fred J. Melville's 'Chats on Postage Stamps.'

Terminology.— Albino.— An impression made either from an uninked embossing die, or from a similar ink die, under which two pieces of paper have been (inadvertently) placed, the upper one alone receiving the color.

BISECT.— A term applied to a moiety of a stamp, used as half the value of the entire label.

BLEUTÉ.— This word implies that the blueness of the paper has been acquired since the stamp was printed, through a chemical reaction.

BLOCK.—An unsevered group of stamps, consisting of at least two horizontal rows of two each.

BOGUS.— Any stamp not designed for use.

BURELÉ.— A fine network forming part of the design of stamp, or covering the front or back of entire sheet.

CHALKY.— Called also *chalk-surfaced.* An overlay on the paper's surface of a coating of chalk or similar substance. It renders the print liable to rub off if wetted; in combination with a doubly-fugitive ink, this renders fraudulent cleaning impossible.

CLICHÉ.— The ultimate production from the die, and of a number of which the printing plate is composed.

COLOR TRIALS.— Impressions taken from a plate in various colors, so that a selection may be made.

DUTY-PLATE.— Many modern stamps are printed from two plates, one being the same (*key-plate*) for all values, the other differing for each denomination; this latter is the *duty-plate.*

ENTIRES.— When used in describing an adhesive stamp, as being «on entire,» this term implies the stamp is on the envelope or letter as when posted.

ENVELOPE STAMP.— A stamp belonging to and printed on an envelope.

ERROR.—An incorrect stamp — either in design, color, paper, etc.— which has been issued for use.

ESSAY.—A rejected design for a stamp; in the French sense also applied to proofs of accepted designs.

FUGITIVE.— Colors printed in «singly-fugitive» ink suffer on an attempt to remove an ordinary ink cancellation; but if in «doubly-fugitive» ink it *was* thought that the removal of *writing*-ink would injure the appearance of the stamp.

GRILLE.— Small plain dots, generally arranged in a small rectangle, but sometimes covering the entire stamp, embossed on certain issues of Peru and the United States. Done to break up the fibre of the paper and allow the ink of the postmark to penetrate it and make cleaning impossible.

GUILLOTINE.—A perforating machine that punches a single straight line of holes at each descent of the needles.

GUMPAP.— Term of opprobrium applied to a stamp issued for sale to collectors and not to meet a postal requirement.

HEAD-PLATE.— See *Duty-plate.*

IMPERFORATE.— Stamps which have not been *rouletted* or perforated.

KEY-PLATE.— See *Duty-plate.*

MINT.— A term showing that a stamp, or envelope, etc., is in exactly the same condition as when issued by the post office — unused, clean, absolutely unmutilated and with all the original gum.

OBLITERATION.— Any mark used in cancellation.

PAIR.— Two stamps joined together as when originally printed.

PANE.— Entire sheets of stamps are frequently divided into sections by means of one or more spaces running horizontally or (and) vertically between similarly sized groups of stamps; each section being termed a *pane.*

PLATE.— A sheet of metal with the stamps engraved on it, also a group of clichés.

PLATE NUMBER.— The consecutive number of each plate, appearing on the margin of the plates and (in some of the British series) on the stamps themselves.

PRE-CANCELLED.— Two or three countries have adopted the system, to save time in the post office, of supplying sheets of stamps cancelled prior to use.

PROOF.— An impression, properly in black, from the die, plate or stone, taken to see if the design, etc., has been properly engraved or reproduced. There are *plate-proofs* as well as *die-proofs.*

PROVISIONAL.—A make-shift intended to supply a temporary want of the proper stamp, which may have been unexpectedly sold out, or may not have been supplied owing to lack of time.

SURCHARGE.— An overprint altering the face value of a stamp, or confirming it in the same or a new currency.

TRIALS.— Impressions from die, plate, stone, etc., taken to ascertain if the design be correct, or to assist in the selection of a color.

TYPE.— A representative common design, as distinguished from «variety,» which indicates slight deviations therefrom.

History.— Adhesive stamps are said to have been invented by James Chalmers of Dundee, Scotland, in 1834, and came into use 6 May 1840, when Parliament had sanctioned their use. M. de Villayer, of Paris, in 1653, invented letter covers or wrappers with a distinctive mark which he sold for two sous (one English penny) as a frank for his collectors who took them from the letter-boxes he established in the chief thoroughfares and delivered to destination addressed on them. In 1839 Parliament passed the Uniform Postage Act. Mr. (later Sir) Henry Cole was secretary of the committee (1838) appointed to inquire into the best methods of charging and collecting postage. Stamped covers, stamped paper and stamps to be used separately were suggested as plans. Cole got Mulready, the artist, to draw a design for the envelope. On passage of the act he got together Wyon the medal sculptor, Henry Corbauld the artist, and Frederick Heath the engraver, and they devised the first penny postage stamp. Heath engraved the world-famous Victoria head and the lettering and the back-ground was «engine-turned,» the curves made with a Rose engine. To Messrs. Perkins, Bacon and Company, London printers, was given the task of printing the «labels» to be impressed by the «Perkins mill and die process,» which has been used ever since on art stamp work. Envelopes, covers, and adhesive stamps were all issued simultaneously on 1 May 1840 but not to be used till 6 May; £2,500 worth were sold the first day, and Cole reported that «about half the letters» mailed were *stamped.* Six more days clearly proved it was *labels* (stamps) the public almost unanimously preferred, and the Mulready allegorical envelope enjoyed less than 1 per cent of the sales, so was soon retired. And thus originated the first postage stamp. Lecky the historian wrote: «The Stamp Act . . . must be deemed one of the most momentous legislative acts in the history of mankind.»

The first postage stamp was the black impression and found a serious drawback; it was printed in a *fast* ink, and the consequence was that those dishonestly inclined washed out the «obliteration» (cancellation) marks and used the stamps over again. In nine months red stamps from this die were produced in a *fugitive* ink. And thus the first stamp (black one penny) naturally became a rarity for collectors early on account of its brief career. It is a source of wonderment how the British got along for such a prolonged period without stamps of any denomination but those of one penny and two pence. For a considerable time «check» letters were used on the four corners of the postage stamp. The first foreign stamp was that issued by Brazil in 1843 (the «bull's eye» which lasted one year), Belgium and France following in 1849. To meet the request of some high officials «cameo» embossed adhesive stamps with the Victoria head were produced to forbid forgery which line engraving had not done. They were done in three valuations (a shilling, two pence and six pence) for use (1847) of the rates to the United States, France, etc. These took 24 processes instead of the former one. Silk threads were embodied in the paper in the shilling and the sixpenny. The issue died out within a decade.

Odd Stamps.— The «albino» stamp is an «error»; it is impressed with an uninked embossing die. An «Omaha» one dollar stamp uses Dunthorne's etching of MacWhirter's painting 'The Vanguard' to which the United States post office gave the title «Western Cattle in a Storm.» Little doubt but some artist imposed on Uncle Sam's innocence of art and accepted the drawing as original. Some stamp specimens have their colors inverted through wrong «feeding» in the press. There are many such odd stamps, but they belong to the subject of philately and stamp collecting.

Commemorative Postage Stamps.— These form a series of historical interest but were issued for postal service. A few might be mentioned here. In 1890 appeared the jubilee «Uniform Penny Postage,» later followed the American Exposition, the Newfoundland (1897), «Queen Victoria Diamond Jubilee» stamp, the Canadian «Founding of Quebec» series, the United States Columbian World's Fair series and the exposition stamps «Omaha,» «Pan-American,» «Buffalo,» «Panama,» etc. A lugubrious reminiscence is the issue by Russia in 1913 of the stamps in honor of the House of Romanoff! In commemoration of the Great War of Europe the Germans used on some of their adhesives the word «Belgian,» lacking foresight of the outcome, not to mention misstatements on freshly issued labels for their colonies, which tell volumes of the Teutonic misconception of her future. The United States three-cent lilac stamp of quite recent memory should act as a reminder of our 50 per cent rise in letter postage during the war period. Speaking of United States postage stamps we should not omit to mention the fact of Uncle Sam not using the effigy of any President or other august personage until after death.

Forgeries, Fakes, Etc.— Naturally, the postage stamp, being a kind of government paper currency, forging of the specimens became an occult art and practice. The first of these false labels came to light as early as 1840, four months after the government's first issue. By 1863 there already existed a sufficiently numerous quantity to justify the compilation and publication of a work detailing and describing these pseudo franking labels. The first of these worthies to accelerate labels in commercial quantities was a Zürich, Switzerland, forger. His specialty was Swiss Cantonals, Modena, Romagna and others, and his agent in Basle obtained *steep* prices for his wares. Next cropped up a Brussels citizen with false Provisional Parma, Modena, Naples and Spain stamps of good execution. From Brunswick and Leipzig issued Danish «essays» and other species of fakes. Very soon thereafter Stourton informed his readers that Glasgow, Manchester, Newcastle, London, Hamburg and New York were competing with the government output. Swiss and Belgian forgers multiplied the number. Bona-fide producers of «facsimiles» were placing such words as «facsimile» or «Falsch» on their colored reproductions of stamps that were printed to aid collectors in identifying specimens of the lesser-known varieties, but the dishonest utilized the opportunity by expunging the fake declaration and selling them as genuine. And the controversy goes on as to whether they do not produce greater harm to the collector than good. Earée's 'Album Weeds' and other works no doubt aid to sift the *chaff* to some extent in the encounter with the great multitude of fakes. Forgeries are produced by *altering* originals as well as by making «facsimiles.» Usually the first are termed «fakes» and the latter «forgeries.» Strangest of the pseudo stamps are the «bogus» ones, designed and invented fiction on paper, the like of which has never been devised by any government but are pure figments of the illicit designer's genius. A great «haul» appears to have been made before 1898 (the date when the fraud was discovered) by forgeries of the green one shilling stamp, 1865 type, with uncolored corner letters. They were used on telegrams and, therefore, had escaped official scrutiny, and unknown masses had gone into circulation. The number of Spanish counterfeits was so large and so persistent that the government had to issue fresh series nearly every year; the Naples and Neapolitan States were bad sufferers. The Indian one rupee stamp, issue 1882–88, had a clever counterfeit, but the culprit was caught. A later fraud is the raised valuation mark on British colonial genuine stamps. While such forgeries and fakes are made at the expense of the government, more have been created with a view of mulcting the collector. Of such are the 10-shilling and the one-pound (on a large anchor) 1878–83 issue imitations done in 1903, apparently, on fiscal water-marked paper, but quickly discovered. A recent fake is a copy of the 1875 twopence halfpenny stamp which was «minted» by the British government with an *error* in the corner-lettering LH-FL instead of LH-HL in the last stamp (12th) of the eighth horizontal row, and, being rare, it tempted fraudulent reproduction. The detection of some forgeries is exceedingly difficult. A well-known philatelist informed the public of a sure (but not advisable) test for differentiating government Cashmere stamps from fakes. His suggestion was to place the label of indeterminate character in water — if the color is fast it is fake, if the water dissolves the color and leaves the paper blank it is genuine. Some sets of forgeries have been self-acclaimed counterfeits, such as the United States of America large 1875–95 stamp for use on newspapers of one cent to $100 valuation. These counterfeits had the words «Falsch» and «Facsimile» printed on each of them, as did some early Japanese frauds (the latter in microscopical characters). Of the *popularity* of certain issues with the fraternity of counterfeiters might be mentioned the fact that the Canton Basle 1845 has 17 counterfeit varieties done by various methods and with varying degrees of ingenuity. The «double Geneva» can boast of at least 15 dishonest rivals, its value «entire» being about $370 unused and about $135 used. Governments (but only a few, be it to their credit) have supplied the fakers with discarded dies and *plates* «for *reprints*» to wreak their worst on innocent collectors or even to make counterfeits for themselves. The United States, in 1875, had new dies made for the 1847 five cents and 10 cents issues for those not in hand so as to produce a complete series of its issues. Their difference is distinguishable, but are they «counterfeits?» The Rumania government, to fill a foreign demand, had three new die types produced for sale as the rare July 1858 stamps. The official fraud was not discovered for a number of years.

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STANCHFIELD, John Barry, American lawyer and politician: b. Elmira, N. Y., 13 March 1855. He was graduated at Amherst College in 1876, later studied law at the Harvard Law School, and was admitted to the bar in 1878. He engaged in practice at Elmira, and in 1878–85 was a partner of David B. Hill. He was district attorney of Chemung County in 1880–85; mayor of Elmira in 1886–88 and a member of the State assembly in 1895–96. After his defeat as Democratic candidate for governor of New York in 1900 he engaged in law practice in New York. He was defeated as Democratic candidate for United States senator in 1901. His career as a lawyer has been markedly successful. In 1915 he was a delegate to the New York State Constitutional Convention.

STAND-PIPE, (1) *in machinery,* a boiler supply pipe of sufficient elevation to enable the water to flow into the boiler notwithstanding the pressure of the steam. Stand-pipes are also used on the eduction pipes of steam pumps to absorb the concussions arising from pulsations and irregularities, caused by the unavoidable employment of bends and change in the direction of pipes. (2) *In hydraulic engineering,* a stand-pipe is a curved vertical pipe, arranged as a part of the main in waterworks to give the necessary head to supply elevated points in the district, or to equalize the force against which the engine has to act.

STANDARD. See Ensign; Flag.

STANDARD, Battle of the, in English and Scottish history, a battle in which David I of Scotland, who had espoused the cause of Maud against Stephen, was signally defeated by the English under the Bishop of Durham. It was fought in the neighborhood of Northallerton, in Yorkshire, on 22 Aug. 1138, and it got its name from the fact that the English forces were gathered round a tall cross mounted on a car, and surrounded by the banners of Saint Cuthbert, Saint Wilfred and Saint John of Beverley. A peace was concluded between the two countries in the following year, David acknowledging the claims of Stephen to the throne of England.

STANDARD OIL COMPANY, The. Two very thrifty young men, John D. Rockefeller and an Englishman named M. B. Clark, after making small savings from their meagre salaries for years and with close financing, determined to pool their little capital. They started a produce commission business in Cleveland, Ohio, in 1858, and were quickly doing a very large turn-over. In 1862 they gave a financial backing of $4,000 to Samuel Andrews to enter into the mineral oil refining business. Andrews by his clever discoveries in refinery improvements soon made the concern wealthy and by 1865 it became the city's “most promising industry.” Rockefeller sold out his interest in the commission business and devoted his time and money to the oil firm of Rockefeller and Andrews. A second refinery was soon started — William A. Rockefeller and Company, with John D.'s brother as partner. H. M. Flagler bought a partnership and was assigned selling quarters in New York City. John D. Rockefeller remained head of all the concerns. Five years after the start in the refining business each of the companies (1870) became combined in the title Standard Oil Company, with a capital of $1,000,000. The partners were John D. Rockefeller, Henry M. Flagler, Samuel Andrews, Stephen V. Harkness and William Rockefeller. The numerous oil refineries were progressing at a marvelous rate, but in three or four years the Standard's progress was so greatly in advance of its rivals that they started an investigation to discover by what means this firm could be getting so far ahead of the others. The Standard Oil Company was found to be receiving rebates from the railroads which were not extended to its 25 rivals in Cleveland. While Cleveland was the largest refining centre in the United States and rapidly gaining in momentum, the Rockefeller interests, by 1870, were the largest operators in that field. The “wise” ones of that thriving city declared that the unflagging energy and commercial talents of the Standard partners assured the concern rapid progress; and the continuance of the extra substantial rebate in transportation cost, in spite of the clamors of its rivals, made their position positively dangerous to competitors. Cleveland still outstripped her rivals in the refining field, but the “Oil Regions” threatened to become a refining centre. Pittsburgh and the Pennsylvania Railroad were making the Cleveland future uncertain. The Standard had to face such facts as that the Pennsylvania Railroad and the Erie Railroad were allying themselves with the Empire Transportation Company and their rivals were putting up a refining plant in Jersey City connected with their pipe line supply. Railroad competition was becoming so keen rebates were given profusely and so much secret dealing was being revealed that each concern suspected its neighbor. The New York Central was forced into the scrimmage in self-protection, and now by 1871 the refining capacity was too great and supply was beyond demand, as so many were rushing into a field that had proven so prosperous. Refined oil prices began to drop. Rockefeller prices of 58¾ cents per gallon in 1865 had fallen to 26⅜ cents by 1870 — his 43 cent margin was wiped out except 17⅛ cents. Added to these ominous conditions foreign sales of refined oil were decreasing rapidly, for Europeans were beginning to import the crude oil and do their own refining. A scheme was set on foot (John D. Rockefeller and H. M. Flagler on oath declared they were not the originators but disbelieved in the plan at first) among the Pennsylvania refiners to combine enough plants and shippers to awe the railroads into giving the combination special rebates “and drawbacks on that of other people.” They felt assured thus the refiners could control the situation and regulate the amount refined and put up prices. The extra rebate had been allowed by the railroads to the Standard Oil Company as shippers of larger quantities than those of competitors. This concern now purchased, secretly, a charter of a company that was in liquidation and which permitted its owners the widest scope of commercial action. It was entitled “Southern Improvement Company” and was owned and organized by a combination of railroad men and oil refiners in 1872. They are said to have obtained control of one-tenth of the refining capacity of the country. Favorable freight contracts were made between the Southern Improvement Company and the Pennsylvania, Erie and New York Central railroads. Nearly all the Cleveland refiners subscribed later and one-fifth of the United States refining capacity was absorbed. In 1874 the Standard Oil Company acquired control of several leading refineries in Pittsburgh and Philadelphia as well as the great plant of Charles Pratt and Company at New York. From 1875 to 1879 the refiners were brought under the control or into the possession of the Standard Oil Company in ever-increasing numbers. All the oil region was gained by the combine and large numbers of works were dismantled and closed. By 1879 the Standard Oil Company held almost a monopoly in oil transportation facilities, including pipe lines, and the Standard “alliance” produced 95 per cent of the country's refined oil; this “alliance” consisting of the principal refining companies from Cleveland to Baltimore. In 1882 the Standard Oil Trust was formed for “convenience of control and management.” It placed all the stock in the hands of trustees and corporations were organized in the different States that had business centres of the trust. The growth of the gigantic concern was steady and its prosperity was uninterrupted. In 1882 the properties under control of the Trust were valued at $75,000,000; by 1892 this valuation had grown to $121,631,312, 50 per cent of the increase being from profits invested. Dividends rose from 5¼ per cent in 1882 to 12 per cent in 1891. But 1892 opened up litigation and a suit to oust the corporation from its corporate rights for “abuse of corporate powers.” The court decided the partnership of corporations illegal and that such a combine was in restraint of trade, illegal, etc. Hence the Standard Oil Company was dissolved into its 20 constituent companies. In 1899 the Standard Oil Company of New Jersey was organized to bring about closer unity and provision for the claims of small holders of trust certificates. The former Standard Oil Company of New Jersey had a capital of $1,000,000, whereas the newer concern had an increased capital of $110,000,000 with power to purchase and own stock of the different corporations, and since 1900 over $97,000,000 of this capital stock had been utilized in purchasing other standard companies at par, the market value based on good will and earnings have been valued at $650,000,000. Suit under the

Sherman Anti-Trust Law was instituted in 1906 in the United States Circuit Court at Saint Louis and its dissolution was ordered by the court, the decision being, on appeal, confirmed by the Supreme Court in 1911. But the distribution pro rata of the stock among subscribers left the strength of the companies a combined power equal to the prior condition. The figures of the earning capacity of the concern appear to range from $8,000,000 from 1882, $15,000,000 from 1886, by 1896 rising to $34,000,000, and in 1905 amounting to $57,459,356. Computation of the income of the entire congeries of companies owned by the Standard is not obtainable. Immense oil well and refining interests are held in the Baku district of Russia, in Mexico, in fact in every section of the world where mineral oil has been discovered in commercial quantities. The great lines of tank steamers crossing the seas to all parts of the globe and owned by the Standard Oil Company have a stupendous value in their entirety.

Bibliography.— Howland, H. J., 'Standard Oil, Illustrated with photographs reproduced from *The Outlook*' (New York 1907); Hubbard, Elbert, 'The Standard Oil Company' (East Aurora, N. Y., 1910); Lloyd, H. D., 'Story of a Monopoly' (extract from *Atlantic Monthly*, New York 1881); Montague, G. H., 'The Rise and Progress of the Standard Oil Company' (New York 1904); Tarbell, I. M., 'The History of the Standard Oil Company' (New York 1904).

STANDARD TIME. See TIME.

STANDARD UNIT OF VALUE. See FINANCIAL PROBLEMS OF THE WORLD WAR.

STANDARDS, Bureau of, a subdivision of the Department of Commerce of the United States, authorized to deal with standards of measurement, standard values of constants, standards of quality, standards of mechanical performance and standards of practice. Its testing laboratories are located at Washington, D. C. The bureau occupies somewhat the same position with respect to the manufacturing interests of the country that the bureaus of the Department of Agriculture do to the agricultural interests. Its work calls for continuous scientific and technical investigations of the highest grade. It compares with its own standards of measurement the standards or measuring instruments of States, cities, scientific laboratories, educational institutions, manufacturers, government bureaus or the public, for which a nominal fee is charged, except in the case of the National and State institutions. The bureau gives advice concerning these standards or their use, whether it be in connection with the enactment of laws, regulations or ordinances concerning the weights and measures of everyday trade or in connection with precision standards used in scientific work and the industries. It gives advice upon request to State and city officials, public service commissions and public utility corporations regarding the standards of measurement, of quality or performance involved in legislation or regulation pertaining to public utilities. It also gives information to manufacturers in regard to standards of measurement, how to use them, how to measure the properties of materials or as to the fundamental physical and chemical principles involved; also, how to initiate and carry out scientific investigations and tests on their own account in their particular fields of work. The staff of the bureau is organized according to the nature of the expert service involved. For example, the division of weights and measures deals with all matters pertaining to standards of length, mass, time, density and similar questions; the division of heat and thermometry deals with heat standards, the testing of heat-measuring apparatus, the determination of heat constants and all investigations where heat measurement is the essential and predominating factor. The electrical division is concerned similarly with the various electrical standards of measurement, the electrical properties of materials or the performance of electrical equipment. Similarly the work of the optical and chemistry divisions deals with the standards and questions arising in connection with these subjects. The structural engineering and miscellaneous materials division deals with the investigation, testing and preparation of specifications for these materials, such as the metals and their alloys, stone, cement, concrete, lime, clay, clay products, paints, oils, paper textiles, rubber and other miscellaneous materials. Its work has greatly expanded and now ranges from the measurement of the radiation of stars to a study of the efficiency and capacity of a vacuum cleaner. After the outbreak of the European War in 1914 the most interesting work of the bureau was that of helping manufacturers to produce at home and out of American materials products for which before they had been dependent upon foreign supplies. Its most notable successes in this field were in the paper and porcelain industries.

In 1915 the total appropriation for this bureau amounted to $695,811.33. Consult *Annual Report* of the Director, Bureau of Standards (Washington), and publications upon definite subjects issued by the bureau from time to time.

STANDARDS OF LENGTH, MASS AND TIME. Standards of length, mass and time are the fundamental units used alike in the business of daily affairs and in the measurements and calculations of physical science.

The most important standards of length now used are the British yard and the international prototype metres. Both of these are legal standards in the United States, the metric system having been legalized in 1866. The relations of the yard and metre are shown by the following equations:

1 yard = 0.9143992 metres.
1 metre = 1.093614 yards.
1 metre = 3.280843 feet.
1 metre = 39.37011 inches.

The most important standards of mass now used are the British pound and the international prototype kilograms. Both are legal standards in the United States. The relations of the pound and kilogram are shown by the following equations:

1 pound = 0.453592428 kilograms.
1 kilogram = 2.20462234 pounds.

The above relations of the yard and metre and the pound and kilogram are the precise values determined by the International Bureau of Weights and Measures. The relations which have been legalized in the United States are:

1 metre = 39.37 inches.
1 kilogram = 2.2046 pounds.

The unit of time adopted by common consent, but used more especially in physical science, is the mean solar second, or 1-86400th part of the mean solar day. The minute, the hour, the day, etc., also in common use, are multiples of the mean solar second. The latter is derived, however, from the time of rotation of the earth, or from the interval between two successive transits of a fixed star across any meridian plane. This interval is called the sidereal day and it is equal in length to 86,164.1 mean solar seconds. The United States Bureau of Standards maintains fireproof vaults where platinum-iridium meter bars and kilogram weights are stored. This bureau makes tests of material for the use of the government, and conducts work looking to the maintenance of standards in all important industries. It has laboratories at Washington and Pittsburgh, and at the latter is the largest testing machine in the world. Consult 'Annual Reports, Bureau of Standards' (Washington, D. C.). See WEIGHTS AND MEASURES.

STANDING STONES. See STONES, STANDING.

STANDISH, Myles, English colonist in America: b. Lancashire, about 1584; d. Duxbury, New England, 3 Oct. 1656. Prior to 1603 he had gained a lieutenancy in the English force then serving in the Netherlands, but after the truce of 1609 joined the Pilgrim or Separatist colony at Leyden, though he never belonged to that communion, and sailed in the *Speedwell* and *Mayflower*. By reason of his experience in martial affairs, Standish was made military adviser to the colonists, and upon their arrival in America he headed exploring and scouting parties. In February 1621 he was chosen unanimously military captain of the colony. His force was always small, though recruited 11 November, and of the numbers and method of warfare of the Indians he knew nothing. But his demonstrations of power soon resulted in some degree of alliance with the powerful tribes along the coasts of Massachusetts Bay. In 1622 Thomas Weston established at Wessagusset (the present Weymouth) an independent settlement which quickly was involved in difficulties with the Indians. A great conspiracy of the savages was thereupon formed, the design being to destroy Plymouth after Weston had been similarly treated. Standish, with a file of eight, marched to Wessagusset, killed the hostile chiefs Pecksuot and Witawamat, defeated the Indians in battle and thus greatly increased the prestige of the struggling colony. He went to London in 1625, to adjust disputes arising with certain merchants who had advanced money on the colony's enterprise, and who at last abandoned their claims on payment of £1,800. In 1628 he arrested Thomas Morton (q.v.), whom he wanted to have shot. The last actual conflict in which he took a part was that in 1635, when he unsuccessfully attempted to dispossess the French who had seized a trading-post established by the colonists on the Penobscot. Besides his military commission, he held also the posts of assistant to the governor, and, from 1644 to 1649, of treasurer of the colony. He was active and soldierly, and by his ability contributed very greatly to decide the success of the settlement. Longfellow's 'Miles Standish' contains numerous anachronisms and inaccuracies. Lowell, also, wrote an 'Interview with Miles Standish.' In 1872 the corner-stone of a monument 110 feet high and surmounted by a bronze figure of Standish was laid at Duxbury. Consult Abbott, J. S. C., 'Miles Standish, Captain of the Pilgrims' (New York 1908); Bradford, William, 'History of Plimouth Plantation, 1606–1646,' edited by W. T. Davis (New York 1908); Morton's 'New England's Memorial' (ed. 1855); Jenks, Tudor, 'Captain Myles Standish' (New York 1905); Johnson, 'Exploits of Myles Standish' (1897).

STANFIELD, stăn'fēld, **William Clarkson,** English painter: b. Sunderland, 3 Dec. 1793; d. 18 March 1867. He began life as a sailor; occupied his spare time in sketching; received an engagement to paint scenery for the Old Royalty Theatre, London; became scene painter at Drury Lane in 1826; was elected a member of the Society of British Artists, and abandoned scene-painting in 1830. Among his pictures may be mentioned 'Mount Saint Michael' (1831); 'The Battle of Trafalgar' (1836); 'The Body of Nelson towed into Gilbraltar' (1853); 'The Abandoned' (1856).

STANFORD, stăn'fōrd, SIR **Charles Villiers,** English composer: b. Dublin, 30 Sept. 1852. He was educated at Cambridge, and continued his musical studies at Leipzig and Berlin. In 1877 a festival overture in B flat by him was performed at the Gloucester Festival, and a symphony at the Crystal Palace. Since that date he has produced numerous compositions in different styles, several of which have achieved a considerable degree of popularity. His best-known work is probably his choral setting of Tennyson's ballad of 'The Revenge,' which was produced at the Leeds Festival in 1886. His operas include 'The Veiled Prophet of Khorassan' (1881); 'Savonarola' (1884); 'Shamus O'Brien' (1896)' and 'Much Ado About Nothing' (1901). In oratorio he has produced 'The Three Holy Children' (1885), and 'Eden' (1891), both written for Birmingham Festivals. His symphonies are an 'Elegiac Symphony' (1882); an 'Irish Symphony' (1887); a 'Symphony in F' (1888); and 'L'Allegro ed il Penseroso' (1895). The most important of his other works may be thus enumerated: a setting of Whitman's elegiac ode on the death of Lincoln (1884); settings of the three cavalier songs by Browning (1884); music for Æschylus' 'Eumenides' (1885) and Sophocles' 'Œdipus Rex' (1887); settings of some psalms; a violin suite (1888); 'The Battle of the Baltic' (1891), a ballad for chorus and orchestra; string quartets; pianoforte sonatas; an ode on the opening of the Chicago Exhibition, the words being by Swinburne; masses, and Irish fantasies for the violin (1894). On the foundation of the Royal College of Music, in 1883, Dr. Stanford was appointed professor of composition and orchestral playing, and in 1887 professor of music at Cambridge. He was knighted in 1902.

STANFORD, Jane Lathrop, American philanthropist: b. Albany, N. Y., 25 Aug. 1825; d. Honolulu, Hawaiian Islands, 28 Feb. 1905. She was married to Leland Stanford (q.v.) and after his death in 1893 was occupied chiefly in fostering the development and extension of Leland Standford Jr. University, which she had aided her husband to establish in memory of their son. In 1901 she increased her gifts to the university by further gifts of securities valued at $18,000,000; her residence in San Francisco, valued at $400,000, for a museum and art gallery; and 1,000,000 acres of land valued at $12,000,000. She subsequently added other benefactions, thus making the university the wealthiest educational institution in the world. Mrs. Stanford established the children's hospital at Albany, N. Y., at a cost of $100,000, and provided an additional $100,000 to secure its maintenance; she also gave over $160,000 to various schools and kindergartens. See Leland Stanford Jr. University.

STANFORD, Leland, American capitalist and philanthropist: b. Watervliet, Albany County, N. Y., 9 March 1824; d. Palo Alto, Cal., 21 June 1893. He studied law and commenced its practice at Port Washington, Wis., but in 1852 went to California and engaged in mining for four years. In 1856 he founded a business in San Francisco which became the nucleus for a fortune estimated at over $50,000,000. In 1860 he entered public life as a delegate to the convention that nominated Abraham Lincoln for the Presidency. About this time he became president of the Central Pacific Railroad, an enterprise in which he was deeply interested financially. He was governor of California, 1861–63; and United States senator, 1885–91. He did much to promote the agricultural development of California and to increase its transportation facilities, but he will probably be longest remembered, however, as the founder of Leland Stanford Jr. University, for which he made an initial gift of $20,000,000. This work, begun in commemoration of his son, was continued by his wife, Jane Lathrop Stanford (q.v.), who erected at Palo Alto a beautful and costly memorial church to his memory. See Leland Stanford Jr. University.

STANG, William, Roman Catholic bishop of Fall River, Mass.: b. Langenbruchen, Germany, 21 April 1854; d. Rochester, Minn., 2 Feb. 1907. Received his primary education in the German Gymnasia and his philosophical and theological training at the American College, Louvain. Ordained priest in Mechlin, 15 June 1878, and came to Providence, R. I., in October of the same year. Was successively assistant and rector of the Cathedral, pastor of Saint Ann's and Saint Edward's parishes, and superior of the Diocesan Missionary Band. He was consecrated first bishop of Fall River in the cathedral, Providence, 1 May 1904. Among his best known works are ‘Life of Martin Luther’; ‘The Eve of the Reformation’; ‘More About the Huguenots’; ‘Germany's Debt to Ireland’; ‘Pastoral Theology’; ‘Historiographia Ecclesiastical’; ‘Theologia Fundamentalis Moralis’; ‘Spiritual Pepper and Salt.’

STANHOPE, stăn'ŏp, an English family, to which three peerages belong: Chesterfield (barony of Stanhope from 1616, and earldom of Chesterfield from 1628); Stanhope (barony, 1717; earldom, 1718), and Harrington (barony, 1729; earldom, 1742). James, 1st Earl Stanhope: b. Paris, 1673; d. London, England, 5 Feb. 1721. He entered the army and served as brigadier-general at the capture of Barcelona in 1705. In 1708 he was appointed commander-in-chief of the British forces in Spain, and in the same year he took Port Mahon, and thus made himself master of the Island of Minorca. After the accession of George I, he devoted himself to politics and became the favorite minister of that monarch, to whom he owed his titles of baron and earl. Charles, the 3d earl, grandson of the preceding; b. London, 3 Aug. 1753; d. Chevening, Kent, 15 Dec. 1816. He invented a printing press and built two calculating machines, and was a patron of science. He approved the French Revolution, openly avowing republican sentiments, and as a member of the House of Lords he favored parliamentary reform, the abolition of negro slavery, the freedom of the press, and the independence of juries. He was father of the celebrated Lady Hester Stanhope (q.v.). The 5th Earl Stanhope (1805–75), grandson of the last noticed, was author of a ‘History of England from the Peace of Utrecht to the Peace of Versailles’ (1713–83).

STANHOPE, Lady Hester Lucy, eccentric English woman, daughter of the 3d Earl Stanhope (q.v.): b. Chevening, Kent, 12 March 1776; d. near Sidon, Syria, 23 June 1839. Her own home was uncongenial and in 1803 she went to preside over that of her uncle, William Pitt, becoming his most trusted confidant. After his death in 1806 she received a pension, but her life being much embittered by her loss of power through his death, and saddened also by the death of her favorite brother and a lover, she left England in 1810, and after traveling over various parts of the East, settled in Syria, where she resided for the rest of her life, living latterly about eight miles from Sidon, at a villa of her own construction, called D'Joun, which was situated on a solitary mountain, remote from any village. The rich presents which she made to the Turkish pashas gave her a great influence over them for a time, though it was afterward greatly diminished. She habitually wore the costume of a Mohammedan chief, and adopted many features of their religion, discovering many similarities in the Koran and the Bible. The Bedouins, or wild Arabs, whom her wisdom and kindness had won, looked up to her, not only as a benefactor, but as a being of a superior order. She is “the crazy Queen of Lebanon” to whom Whittier alludes in ‘Snow-bound.’ Her guests also included Lamartine (1832) and Kinglake (1835). Consult Kinglake, ‘Eothen’; Meryon, ‘Memoirs of Lady Hester Stanhope’ (1846); Hamel, ‘Lady Hester Lucy Stanhope’ (New York 1913).

STANISLAUS, stän'ĭs-lâs, or **STANISLAS I, Leszcynski,** lĕs-chün'skē, king of Poland: b. Lemberg, Galicia, 20 Oct. 1677; d. 23 Feb. 1766. In 1704, being then woywode of Posnania, and general of Great Poland, he was deputed by the assembly of the states at Warsaw to wait upon Charles XII of Sweden, who invaded the kingdom with the view of dethroning Augustus of Saxony. Charles immediately resolved to raise him to the throne of Poland, which he effected at an election held in July 1704. He was, however, soon after driven from Warsaw by his rival Augustus; but another change brought him back to that capital, where he was crowned, with his wife, in October 1705; and the next year Augustus was compelled formally to abdicate. The fatal defeat of his patron, Charles XII, at Pultava, in 1709, again obliged him to retreat into Sweden, where he endeavored to join Charles at Bender, in disguise; but, being detected, he was held captive in that town until 1714. He remained in obscurity until 1725, when his daughter, the Princess Mary, was selected as a wife by Louis XIV, king of France. On the death of Augustus. in 1733, an attempt was made by the French court to replace Stanislaus on the throne of Poland; but, although a party supported him and proclaimed him king, his competitor, the electoral Prince of Saxony, being aided by the emperors of Germany and Russia he was obliged to retire. He endured this, like every other reverse of fortune, with great resignation, and at the peace of 1736, formally abdicated his claim to the kingdom ot Poland, on condition of retaining the title of king, and being put in possession for life of the duchies of Lorraine and Bar. Thence forward he lived as the sovereign of a small country, and acquired the appellation of «Stanislaus the Beneficent.» He not only relieved his people from excessive imposts, but, by strict economy, was able to found many useful charitable establishments, and to patronize the arts and sciences. He wrote some treatises on philosophy, morals and politics, which were published under the title of 'Œuvres du Philosophe bienfaisant' (8vo. 1765). Consult Des Reaulx, 'Le Roy Stanislas et Marie Leszcynski (Paris 1895).

STANISLAUS, or **STANISLAS II, Augustus**, the last king of Poland, son of Count Stanislaus Poniatowski: b. Woczyn, Lithuania, 17 Jan. 1732; d. Saint Petersburg, 12 Feb. 1798. In 1752 he first appeared as a deputy in the Polish diet, where he soon attracted attention by his oratory. Augustus III sent him on a mission to the Empress Elizabeth at Saint Petersburg, and on this occasion he acquired the peculiar favor of the Princess (afterward Empress) Catharine. After the death of Augustus, the influence of Catharine secured the election of her favorite as his successor (Sept. 1764), and he was crowned at Warsaw on 25 Nov. 1764. Although of excellent ability and noble disposition, he was yet unable to do anything for the good of his country, because he lacked the strength of character necessary to check the license of the nobles, and to withdraw himself from Russian influence. In 1772, when the first partition of Poland was made, Stanislaus in vain protested against it, while his resistance to the second partition of Poland had only this consequence, that after the capture of Warsaw the Empress Catharine caused him to be brought to Grodno, where he was compelled to sign the treaty for the third partition of Poland, and on 25 Nov. 1795, also to sign his own abdication. After the death of Catharine, Paul I brought him to Saint Petersburg, where he lived for the rest of his life on a pension allowed him by the emperor. Consult 'Memoires secrets et inédits de Stanislas' (1862); Bain, 'The Last King of Poland' (1909).

STANLEY, stăn'lĭ, **Arthur Penrhyn**, English Anglican clergyman and author, popularly known as Dean Stanley: b. Alderley, Cheshire, 13 Dec. 1815; d. London, 18 July 1881. He was educated first at Rugby, where he conceived an abiding love and veneration for Dr. Thomas Arnold (q.v.) and gained a unique position in the school. In 1834 he entered Balliol College, Oxford, where he had a brilliant career and in 1838 was elected a Fellow of University College. He took deacon's orders in 1839 and priest's in 1843, became a college tutor in 1843 and was appointed in 1845 preacher to Oxford University. In that capacity he preached four sermons, which were published as 'Sermons on the Apostolic Age,' in 1847, at a critical time in the religious history of Oxford. In these Stanley stood aloof from both the Evangelicals and the high churchmen, taking, rather, a rationalistic position. He was presented to a canonry of Canterbury in 1851 and shortly afterward traveled extensively in Palestine and Egypt. In 1856 he was appointed professor of ecclesiastical history at Oxford and canon of Christ Church, and in 1863 was made dean of Westminster. In this position, as the acknowledged head of the Broad Church party, he exercised an important influence, though the width of his sympathy and his tolerant spirit exposed him to attacks from many of narrower views within the Anglican Church. In 1863 he married Lady Augusta Bruce, daughter of the 7th Earl of Elgin (died 1876), to whom he owed much of his social popularity. He visited America in 1878 and delivered many notable sermons and addresses (see bibliography). He was the author of numerous works, among which are 'Life of Arnold' (1844); 'Memoir of Bishop Stanley,' his father (1850); 'Memorials of Canterbury Cathedral' (1854); 'Commentary on the Epistles to the Corinthians' (1855); 'Sinai and Palestine' (1856); 'Three Introductory Lectures to the Study of Ecclesiastical History' (1857); 'Lectures on the History of the Eastern Church' (1861); 'Lectures on the History of the Jewish Church' (1863–76); 'Sermons in the East' (1863); 'Memorials of Westminster Abbey' (1868); 'Essays on Questions of Church and State' (1870); 'The Athanasian Creed' (1871); 'Lectures on the History of the Church of Scotland' (1872); 'Addresses and Sermons delivered at St. Andrews' (1877); 'Addresses and Sermons delivered in the United States and Canada' (1879); 'Christian Institutions' (1881). The breadth and tolerance characteristic of Stanley's religious views were well shown in his attitude toward Bishop Colenso, whom he supported without endorsing his opinions on the Pentateuch and in his article on the famous 'Essays and Reviews' contributed to the *Edinburgh Review* of April 1861. Consult Bradley, 'Recollections of Arthur Penrhyn Stanley' (1883); Prothero, 'Life and Correspondence of Dean Stanley' (1893) and 'Letters and Verses of Dean Stanley' (1895).

STANLEY, David Sloane, American soldier: b. Chester, Ohio, 1 June 1828; d. 1902. He was graduated from West Point Military

Academy 1852. As an officer in the Federal army he took an active part in the Civil War, commanding a division at Iuka and serving in the battles of the Atlanta campaign. He was promoted brigadier-general, United States army, in 1884, later was brevetted major-general and was retired 1892.

STANLEY, Sir Henry Morton, Anglo-American explorer: b. near Denbigh, Wales, 28 Jan. 1841; d. London, 10 May 1904. His name was originally John Rowlands and at three he was placed in the poorhouse at Saint Asaph, where he remained for 10 years, making such progress that when he left the institution he was engaged as an instructor for other children at Mold, Flintshire. In 1857 he sailed as cabin-boy on a vessel bound for New Orleans, where he was adopted by a merchant who gave him his name, but who died without making a will, thus leaving his adopted son penniless. At the outbreak of the Civil War Stanley entered the Confederate army but was shortly afterward taken prisoner and when discharged volunteered in the United States navy and later became acting ensign on the ironclad *Ticonderoga*. At the close of the war he went to Turkey and Asia Minor as a newspaper correspondent and in 1867–68 was engaged as special correspondent for the New York *Herald* on the Abyssinian expedition, winning a reputation as a journalist by sending his account of Lord Napier's victory to London in advance of the official despatches. He represented the same paper in Spain during the Carlist War in 1868 and in 1869 accepted the mission from the proprietor of his paper «to go and find Livingstone,» from whom no tidings had come for more than two years. He was given full control of the expedition and after attending the opening of the Suez Canal, visiting Constantinople, the Crimea, Palestine, the valley of the Euphrates, Persia and India, he set sail from Bombay, for Africa, 12 Oct. 1870. He reached Zanzibar on the eastern coast of Africa in January 1871, organized an expedition of 192 men, divided them into five parties and set out on 21 March. He found Livingstone at Ujiji on Lake Tanganyika, 10 Nov. 1871 and remained with him four months, after which, the veteran explorer refusing to abandon his enterprise until it was completed, Stanley furnished him with supplies and returned to England. In 1874 Stanley set out on a second African expedition under the auspices of the New York *Herald* and the London *Daily Telegraph*. Reaching Zanzibar in the autumn of that year, he learned of Livingstone's death and resolved to shape his course to the northwest. He explored the equatorial lake region, circumnavigated for the first time Victoria Nyanza, proving it to be the largest-fresh-water lake in the world instead of a series of lagoons, discovered the Shimeeyu River and afterward, continuing to the westward, discovered that Albert Nyanza was not connected with Lake Tanganyika as had been supposed. He returned to England in 1878 having on his return journey traced the Kongo River from its source to its mouth. In 1879 he again set out for Africa on the Belgian enterprise, which resulted in the development of the Kongo Free State. He visited the United States in 1886 on a lecturing tour and in 1887 organized the relief expedition in search of Emin Pasha whom he met on the Albert Nyanza 28 April 1888 and escorted him to the east coast discovering the Ruwenzori Mountains south of Albert Nyanza on the return trip. He reached England in 1890, visited the United States and Australia, on lecturing tours in the following year and in 1895–1900 sat in Parliament for North Lambeth. He was knighted in 1899. His publications include ‹How I Found Livingstone› (1872); ‹Through the Dark Continent› (1878); ‹The Congo, and the Founding of its Free State› (1885); ‹In Darkest Africa› (1890); ‹My Dark Companions and Their Strange Stories›; ‹Slavery and the Slave Trade in Africa› (1893); ‹Through South Africa› (1898), etc. Consult his ‹Autobiography,› edited by his wife (London 1909); Wauters, A. J., ‹Stanley's Emin Pasha Expedition› (London 1890).

STANLEY, Thomas, English scholar: b. Comberlow, Hertfordshire, 1625; d. London, 12 April 1678. He was graduated at Cambridge in 1641, but held also a master's degree at Oxford. He entered the Middle Temple and practised law all his life, but is best known as a scholar. His works include translations from the Greek, Latin, French, Spanish and Italian poets; the ‹History of Philosophy› (1655–62), dealing with the Greek philosophers, and an edition of Æschylus (1663–64), with Latin translation and commentary. These two works long remained standards, the latter being translated into several languages.

STANLEY FALLS, Kongo Free State, a cataract and an important trading station on the Kongo River about 1,400 miles from its mouth; also an administrative district of the Kongo State.

STANLEY POOL, Kongo Free State, a lake-like expansion of the Kongo River, 325 miles from its mouth and about 80 square miles in area. It was discovered in 1877 by Stanley, who founded here the station of Leopoldville, which became the principal base for trade and exploration in the Kongo Basin. Stanley Pool is also the name of an administrative district of the Kongo State.

STANNARD, stăn'ạrd, **Henrietta Eliza Vaughan Palmer** («John Strange Winter,» «Violet Whyte»), English novelist: b. York, England, 13 Jan. 1856; d. 1911. She was married to Arthur Stannard in 1884. She was a prolific writer after her first appearance in print in 1874, her novels numbering above 70. She was the first president of the Writers' Club in 1892. Among her works, chiefly tales of army life, are ‹Cavalry Life› (1881); ‹Bootles's Baby› (1885); ‹A Siege Baby› (1887); ‹Heart and Sword›; ‹A Blaze of Glory›; ‹Uncle Charles›; ‹Cherry's Child,› etc.

STANNARIES, mines from which tin-bearing ore is dug. The most noted stannaries are those of Devon and Cornwall in England. Around the mines of these two counties there has arisen a body of law and customary usage peculiar to the locality and not imitated or duplicated in any other mines in England. By early usage the prerogative of the Crown was extended so as to cover these tin mines, although elsewhere it reaches only to gold and silver. King John in a charter to the tinners gave them the privilege of mining and working anywhere in the two counties and this was confirmed by subsequent monarchs, until Edward III created his son Duke of Cornwall with the stannaries as a perpetuity of the duchy. The Duke who is now always the Prince of Wales is represented by a warden and vice-wardens. In former times representative assemblies of the tinners (called parliaments) were summoned by the warden for the regulation of the stannaries and redress of grievances: the last of them was held in 1752. The Stannary Courts are courts of record held by the warden and vice-warden (of the same limited and exclusive character as the courts-palatine), in which the tinners have the privilege of suing and being sued. They were remodeled and regulated by a series of acts of Parliament. Appeals from them are now taken to the Court of Appeals, and finally to the House of Lords.

STANNITE, or TIN PYRITES, a brittle gray or black tin ore, popularly called «bell metal ore» by the miners of Cornwall, England, its chief locality. It is identical with tin pyrites, and was only known massive until recently discovered in small tetrahedral crystals in Bolivia. Its hardness is 4; specific gravity 4.3 to 4.5; streak blackish; color steel-gray to iron-black. It is a sulphide of tin, copper, iron and some zinc.

STANOVOI (stä-nō-voi') **MOUNTAINS,** Siberia, a mountain range traversing eastern Siberia from the northern boundary of Mongolia to the Bering Strait. Its general course is northeast, but after traversing the Transbaikal district and running along the northern boundary of the Amur district, it skirts the shores of the Sea of Okhotsk in a large zigzag. It terminates in East Cape on the Bering Strait. Its total length is about 2,600 miles. The southwestern portion, which is known as the Yablonoi Mountains, is less regular than the northern branch and spreads out into numerous parallel chains and transverse spurs. This part is heavily forested, while the forests disappear north of the 60th parallel. The Stanovoi range proper is a steep mountain-wall with rugged peaks reaching a height of over 8,000 feet. The whole range forms the divide between the Arctic and Pacific oceans. and feeds the Yenisei, Lena, Indigirka, Kolyma and Amur rivers.

STANOYEVICH, Milivoy Stoyan, Serbian essayist and author: b. Koprivnica, Kraina, Serbia, 14 Feb. 1882. He studied at Belgrade University, where he successfully competed for academic prizes in literary essays. He graduated from that institution in 1907, and was immediately appointed professor *ad interim* of modern languages at Zaječar College. He came to the United States in 1908 and continued his pursuits in literature, sociology and economics at Columbia University and the University of California, receiving from the last-named institution his degree of M.L. (1914). In 1915 he became a lecturer on Slavonic literature at the University of California, and in 1916 he was nominated as political adviser on Slavic affairs in the office of the Russian consul-general at San Francisco. He has been editor of several Jugoslav publications and frequent contributor to the American periodicals, besides having written 'Omladina u Sadašnjosti' (1907); 'Figure u Pesmama' (1907); 'Prevodi u Srpskin Zabavnicima' (1908); 'Veština Pisanja' (1915); 'Pessimisme et Optimisme dans la Sociologie' (in joint collaboration with his brother, Milosh S.) in 1913; 'Tolstoy's Theory of Social Reform' (1914); 'Russian Foreign Policy in the East' (1916), etc. His writings are marked by a fresh and vigorous style, by refined simplicity and incisive diction. His studies are full of delicate observations of human nature and he may be justly regarded as a representative writer of Serbian prose.

STANTON, Edwin McMasters, American statesman and jurist: b. Steubenville, Ohio, 19 Dec. 1814; d. Washington, D. C., 24 Dec. 1869. His paternal ancestors were Quakers originally from Massachusetts but later settled in North Carolina, and his mother was a Virginian. At the age of 13 upon his father's death he began to work, and at 17 entered Kenyon College but was obliged to leave after two years for lack of means. After three years of study he was admitted to the bar in 1836 and married.

He joined the Democratic party on the issue of nullification, and in 1837 was elected prosecuting officer of his county. After serving for two years he returned to private practice, and in 1847 he moved to Pittsburgh where he soon took rank among the leaders of the Pennsylvania bar. In 1856 he changed his residence to Washington, and in 1858 was sent to California as special counsel of the United States in the cases growing out of land grants made by the Mexican government before the treaty of 1848. He added greatly to his reputation by his conduct of this litigation. During these years he took no part in politics but sympathized with the Free-soil wing of the Democratic party and favored the Wilmot Proviso. In 1856 he supported Buchanan, and in 1860 voted for Breckenridge, believing that the election of Lincoln would imperil the Union.

When Buchanan's Cabinet divided in December 1860 and Cass, the Secretary of State, resigned, Attorney-General Black took his place and Stanton was made Attorney-General 20 Dec. 1860, the day when the ordinance of secession was adopted in South Carolina. At his first Cabinet meeting the question was presented whether Major Anderson should be ordered back to Fort Moultrie. Floyd, the Secretary of War, and his southern associates insisted that this should be done, while Stanton with Black and Holt vigorously opposed them, threatening to resign if such orders were issued. Their attitude drove the secessionists from the Cabinet and redeemed the close of Buchanan's administration. During the remainder of the administration he was active in studying the plans of the secessionists and considering how to defeat them and protect Washington. He feared insurrection or assassination to prevent Lincoln's inauguration, and his influence helped to persuade President Buchanan that regular troops should be ordered to Washington.

The attack on Fort Sumter found him a strong supporter of the national authority and outspoken in calling upon all loyal men to stand by the government. On 13 Jan. 1862, Mr. Lincoln appointed him Secretary of War in place of Simon Cameron. Stanton had criticized Lincoln severely and had not even met him since his inauguration, but Lincoln selected him for his ability and because he was a representative of the Democratic Unionists, whose support was essential. The wisdom of the choice was signally vindicated. The whole system of the War office was inefficient and reorganization was imperatively demanded. Stanton brought to his work great executive ability, prompt decision and a strong will which made itself felt through the whole military service. He had scant patience with men who were seeking personal advantages, or with frivolous calls upon his attention. Hence his manner was brusque, impatient and decided, and he made many enemies.

He advised the passage of a law authorizing the President to take possession of all the railroad and telegraph lines of the United States, and this was at once enacted. He ordered that all contracts for supplies and munitions be in writing, appointed a commission to investigate and determine what valid contracts were outstanding, and waged vigorous war upon fraudulent contractors. By an order of 14 February he directed the release of all persons who had been arrested on suspicion of disloyal practices, with certain exceptions, upon their giving their parole not to aid the rebellion. From that time such arrests were made only under military authority, which was exercised on the theory that all doubts were to be resolved in favor of the country. No part of Stanton's career shows more loyalty to his country than his patience with McClellan during the first six months of 1862, but the latter's delay in moving his army to the support of Pope, his disregard of orders, and his whole conduct during the critical weeks which preceded Lee's invasion of Maryland at length satisfied Stanton that he should be removed, and in the last days of August he tried to unite the Cabinet in recommending this step, but Mr. Lincoln felt that McClellan's popularity and the political situation made it necessary to give him the command of the army. Stanton disapproved this action as did Mr. Chase, but the President took the responsibility. McClellan's conduct of the Antietam campaign, his inexcusable delays and almost direct insubordination increased Stanton's feeling and at length convinced the President, and McClellan was dismissed from active service.

Taking office as a Democrat, Stanton early felt the importance of emancipation as a war measure, and when on 22 July 1862, Mr. Lincoln laid before the Cabinet a proclamation declaring that all slaves in the seceded States should be free on a fixed day, Stanton and Bates, the Attorney-General, were in favor of issuing it at once, while Seward and Chase opposed it. Stanton approved the issue of the proclamation after Antietam, and in his annual report made a powerful argument in support of the measure. When in the next year after the defeats of Fredericksburg and Chancellorsville, Lee a second time crossed the Potomac, Hooker was relieved and Meade appointed to the command by Stanton's advice, and during the critical summer and autumn of 1863 he met every emergency successfully.

When it was apparent that General Rosecrans was not in a condition to retain the command, Stanton summoned Grant from New Orleans to Louisville, himself met him there and after a full conference placed him in command of the Western armies, giving Thomas command at Chattanooga. The immediate success of General Grant in his new command with the crushing defeat of Bragg's army made the whole military situation much clearer, and General Grant's appointment to the command of the army and his removal to Virginia followed as a matter of course. After Appomattox, General Sherman agreed upon terms with General Johnston, which provided not only for the surrender of the latter's army but for the settlement of vital political questions, and the agreement was disapproved by the Administration. Stanton stated the reason in a dispatch to General Dix that the public might understand why General Sherman was overruled. His statement was clear and poignant and while it reflected on General Sherman's discretion in consenting to such an arrangement, the general himself was not criticized. Sherman held Stanton especially responsible for the action of the government and became very hostile to him.

Nothing in the history of the Civil War is more remarkable than the speed with which the vast armies of the United States were dissolved. On 1 May 1865, a million men were on the rolls of the army. In hardly more than 60 days nearly 700,000 of them were returned to their homes. The grand review of the two great armies held in Washington 22 and 23 May 1865 showed the military force of the United States at its greatest. In little more than a month most of that force was engaged in the labors of peace. Stanton had made this possible.

Stanton remained in the Cabinet of President Johnson, and in the struggle between the President and Congress over the policy of reconstruction, sympathized with Congress. He felt that the President's policy meant the return of the disloyal element to power in the Southern States and he could not contemplate such a result without indignation. The partisans of the President demanded his resignation, while the leading Republicans besought him to remain, feeling that his presence in the War Department was an insurance against violence. His position was extremely disagreeable, but he held it with persistent courage, taking no part in the discussion and making no public expression of his views. He simply remained at his post and discharged his duty. The Tenure of Office Act had been passed in part to prevent the removal of Stanton. He opposed its passage, advised the President to veto it and desired its defeat after the veto.

This act and the provision that the President should issue orders to the army only through the general of the army, effectually took the control of the army away from the President and he wished to regain it. When Congress adjourned in the summer of 1867 the President sounded General Grant as to removing Stanton from office. Grant counseled him against it. Thereupon the President asked for Stanton's resignation, which was refused and the refusal was applauded by the Republican leaders. A week later the President suspended him from office without stating any cause and directed him to turn over all public records and property to General Grant, whom he appointed Secretary *ad interim*. Stanton in reply denied

his right to suspend him without legal cause, but under protest obeyed the order. When Congress reassembled in December 1867 the Senate refused to concur in the suspension and Stanton was thus reinstated. The President was very much irritated and after an interval spent in endeavoring to persuade General Sherman to accept the position, removed Stanton on 21 Feb. 1868 and appointed Lorenzo Thomas Secretary of War *ad interim*. Stanton declined to obey this order, the Senate by resolution denied the President's power to remove him and the House voted to impeach the President. The trial of the President followed and ended on the 26th of May, and during its progress General Schofield had been nominated to the Cabinet as Secretary of War. When the Senate failed to convict the President, Stanton at once retired and the nomination of Schofield was confirmed.

He left the office which he had held for more than six years, a comparatively young man, but broken in health by the unremitting toil and anxiety which he had undergone. His income which had been considerable when he took office had been so reduced that he had nothing but his house in Washington, and he was obliged to resume the practice of his profession. He argued several important cases, but his powers were exhausted, and he gradually failed. His last argument was made at a hearing in his own library in December 1869, and he never left the house again. The approaching resignation of Judge Grier made a prospective vacancy on the Supreme Bench and on the recommendation of the leading men in both Houses of Congress, President Grant nominated Stanton to the place on 20 Dec. 1869. His nomination was at once confirmed and he lived to feel the pleasure of receiving the only office which he ever desired, but his work was done and he died four days later. A sincere, unselfish, patriotic man, the result of the Civil War was due in no small part to his labors. Consult Gorham, G. C., 'Life and Public Services of Edwin Y. Stanton' (2 vols., Boston 1899); De Witt, D. M., 'The Impeachment and Trial of Andrew Johnson' (New York 1903); Flower, F. A., 'Edwin McMasters Stanton' (Akron, Ohio 1905).

MOORFIELD STOREY,
Author 'Life of Charles Sumner.'

STANTON, Elizabeth Cady, American reformer: b. Johnstown, N. Y., 12 Nov. 1815; d. New York, 26 Oct. 1902. She was graduated from Emma Willard Seminary, Troy, N. Y., in 1832 and was married to Henry Brewster Stanton (q.v.) in 1840. Her attention was first attracted to the disabilities of her sex when at 15 she was prepared to enter college and found none in which she could obtain the education which her brothers received. She afterward studied Blackstone, Story and Kent, and while in London, in 1847, met Lucretia Mott, with whom in the following year she issued the first call for a woman-suffrage convention to be held in her home at Seneca Falls. From that time her career was one long struggle for equal rights for both sexes. The general principles for which she strove were equal educational advantages, equal rights of suffrage and of property, and more intelligent divorce laws. She addressed the New York legislature on the rights of married women in 1854 and again in 1860, advocating divorce for drunkenness. In 1866, she offered herself as a congressional candidate and for 25 years annually addressed congressional committees in the endeavor to gain a constitutional amendment granting enlarged privileges to women. She was president of the Women's Loyal League in 1861 and of the National Woman Suffrage Association in 1865–93. She traveled and lectured in all parts of the United States and also made addresses in England, Scotland and France. Throughout her entire career, Mrs. Stanton's personal life was a model of the fulfilment of the duties of a wife and mother, her public career never operating to the neglect of her social and home life. While the changes which have been wrought cannot definitely be declared the result of the exertions of Mrs. Stanton and her immediate associates, a great change certainly came about in her lifetime. The education within the reach of her brothers but unattainable for herself in her girlhood is now within the reach of any determined girl, and the changes in legislation are even more noticeable. The laws which placed a woman's property absolutely at her husband's disposal have been replaced by those which give her equal rights with him, or possibly superior, since the law recognizes no claim on the woman for family support, and her earnings are her own. Her intellect, energy and perseverance, and her womanly traits made her generally respected, and she is rightfully regarded as the mother of the movement. She presided over the first International Council of Women held in Washington in 1888, was one of the founders and afterward editor of *The Revolution*, and a frequent contributor to English and American magazines. She published 'Eighty Years and More' (1895); and was joint author of 'The History of Woman Suffrage' (1881–86) and edited 'The Woman's Bible' (1895).

STANTON, Frank Lebby, American journalist and poet: b. Charleston, S. C., 1857. He has resided in Atlanta, Ga., since 1894 and is now on the editorial staff of the Atlanta *Constitution*. He has published 'Songs of the Soil'; 'Comes One With a Song' (1898); 'Songs from Dixie Land' (1900); and 'Up from Georgia' (1902); and 'Little Folks Down South.'

STANTON, Henry Brewster, American abolitionist: b. Griswold, Conn., 29 June 1805; d. New York, 14 Jan. 1887. He was prominent in the anti-slavery movements of 1837–41. In 1847 he was admitted to the bar and achieved a high reputation in patent law. In 1858–60 he assisted in the reorganization of the Republican party, and from 1868 was on the editorial staff of the New York *Sun*. He has published 'Sketches of Reform and Reformers in Great Britain and Ireland' (1849); 'Random Collections' (1886).

STANTON, Robert Brewster, American civil and mining engineer: b. Woodville, Miss., 5 Aug. 1846. He graduated at Miami University — A.B., 1871; A.M., 1878; (hon. A.M. University of Wooster, 1885); was resident engineer Cincinnati Southern Railroad, 1874–80; division engineer Union Pacific Railway, 1880–84. Since 1884 has been in private practice as consulting civil and mining engineer. Among other engagements made survey as chief engineer through the Grand Cañon of the Colorado, 1889–90; special work on the British Columbia landslides for the Canadian Pacific Railway, 1896; examined and appraised the value of railroads in the States of Michigan, Kansas and Washington, 1906 and 1910; located railroad line from Chicago to Saint Louis, 1902, and from Butte, Mont. to Boise, Idaho, 1905. He engaged in mining operations and explorations at various times from 1884 to the present date, throughout the United States, Canada, Mexico, the West Indies and the Dutch East Indies; engineer and general manager, Flint Idaho Mining Company, 1886–88; and the Hocumac Mining Company, 1893–94; special work in copper and nickel mines in Canada, 1892 and 1903; explored and examined gold mines in the Island of Sumatra, 1904; examined and reported upon the Cananea, Mexico, copper mines, 1906; gold mines in California, 1893, 1903 and 1907, and in Utah and Arizona 1898–1901; manganese mines in Washington, 1910; gold mines in Nova Scotia, 1913 and on iron and manganese mines in Cuba, 1909–14. He is the author of 'Availability of the Cañons of the Colorado River for Railway Purposes' (1882); 'The Great Landslides of the Canadian Pacific Railway,' etc (1898), and monographs and lectures on the Grand Cañon.

STANWIX, stăn'wĭks, **John,** English soldier: b. 1690; d. Irish Channel, December 1766. He entered the army in 1706, was made lieutenant-colonel, 1745; and governor of Carlisle 1752. After General Braddock's defeat Stanwix was sent to America in command of a battalion of the Royal Americans, and in 1758 was made brigadier and sent up the Hudson to the Oneida portage where he built Fort Stanwix. In 1759, while Wolfe was storming Quebec, he was in command in Pennsylvania, rebuilt Fort Duquesne, was promoted to major-general, and returned to England in 1760. He was made lieutenant-general in 1761 and governor of the Isle of Wight in 1763.

STANWOOD, stăn'wŭd, **Edward,** American editor and author: b. Augusta, Me., 16 Sept. 1841. He was graduated at Bowdoin College in 1861 (Litt.D., 1894), was assistant editor of the *Boston Daily Advertiser,* 1867–82, and editor, 1882–83, and managing editor of the *Youth's Companion,* 1884–1913. He has published 'History of Presidential Elections' 1884; 'History of the Presidency' 1898; 'American Tariff Controversies in the Nineteenth Century' 1903; 'The Life of James G. Blaine' 1905; Volume 2 of 'History of the Presidency' 1912.

STANYUKOVITCH, Konstantin Mikhailovitch, Russian author: b. Sevastopol, 1844; d. 1903. He was the son of an admiral and entered the navy at 16, but resigned in 1864 and thereafter devoted himself to literary work at Saint Petersburg. His work, consisting of sea stories, social studies and humorous sketches, appeared in the leading Russian journals, later appearing in book form. Among his numerous works the more important are 'The Sincere People'; 'The Story of One Life'; 'The Indifferent People'; 'Priests'; 'Sea Tales.' His collected works were published (Saint Petersburg 12 vols., 1906–07).

STANZA, a group of four or more lines so connected with each other by metre and rhyme as to form one of the regular divisions of a poem. The use of the word stanza for a two-line verse is not to be commended. Two rhymed lines form a couplet, three a triplet. Stanzas are usually from four to 16 lines in length, and the lines mostly rhyme alternately or in couplets, though other arrangements are frequent. In Byron's 'Don Juan,' the eight lines are rhymed thus: 1 2 1 2 1 2 3 3, the same figures indicating rhymes. This particular form of stanza is called the *ottava rima.*

STAPELIA, a genus of cactus-like plants of the family *Asclepiadaceæ,* about 80 species of which are natives of South Africa. They have angular, generally four-sided, leaflets, green stems and branches, covered with excrescences; bear large, showy, grotesquely mottled or barred flowers irregularly in angles and notches of the stems. Because of their fetid odor they are popularly known as carrion-flowers, a name shared by several other unrelated plants. The flowers are frequently disproportionate to the size of the plant; for example, *S. gigantea* produces flowers about a foot in diameter. Except in fanciers' collections and in botanic gardens these plants are rarely cultivated, probably because of their smell.

STAPFER, Paul, French author: b. Paris, 14 May 1844. He was educated at the Bonaparte Lyceum, Paris. He was professor of foreign literature at Grenoble in 1881–83, then accepting a similar chair at the University of Bordeaux. He contributed to the *Temps* and other leading magazines, and is known as an essayist of profound learning and exquisitely finished style. He edited the 'Grands écrivains' series and is author of 'Petite comédie de la critique littéraire de Molière' (1866); 'Shakespeare et l'antiquité' (2 vols., 1883); 'Racine et Victor Hugo' (1886); 'La Grande prédication chretienne en France' (1898); 'Questiones esthétiques et religieuses' (1906); 'Vers la vérité' (1909; 'Les leçons de la guerre' (1915), etc.

STAPLES, stā'plz, **Robert Ponsonby,** English artist: b. 30 June 1853. He received his instructions in art at the Louvain Academy of Fine Arts (1865–70); at Brussels under Portaels, and at Dresden (1867). In 1869 he visited Paris and exhibited at the Royal Academy, Burlington House (1875). He subsequently passed a year in Australia (1879–80). He served as Art Master of the People's Palace, Mile-end Road (1897). His chief works are 'Guilty or Not Guilty'; 'The Last Shot for the Queen's Prize, Wimbledon'; 'Cardinal Manning's Last Reception'; 'Mr. Gladstone introducing the Home Rule Bill'; 'The Queen and King Edward VII,' etc.

STAPLES, William Read, American jurist and historian: b. Providence, R. I., 10 Oct. 1798; d. there, 19 Oct. 1868. He was graduated at Brown University in 1817, and was admitted to the bar in 1819. He was associate justice of the Rhode Island Supreme Court in 1835–54, and chief justice of that court in 1854–56. He then resigned because of failing health. From 1856 he was secretary and treasurer of the Rhode Island Society, and he was one of the founders of the Rhode Island Historical Society. He was an authority on the history of Rhode Island, and edited the second volume of the Historical Society's collections, as well as Samuel Gordon's 'Simplicities' Defense against Seven-Headed Policy' (1835). Author of 'Annals of Providence to 1832' (1843); 'Documentary History of the Destruction of the «Gaspé»' (1845); 'Proceedings of the First General Assembly for the Incorporation of the Providence Plantations in 1647' (1847); 'Rhode Island Form-Book' (1859).

STAPLES, Minn., city in Todd County, 120 miles northwest of Minneapolis, on the Northern Pacific Railroad. It has railroad repair shops, and is important as a railroad division headquarters and transfer point. It was settled in 1892. Pop. 2,558.

STAR-ANISE, the fruit of a shrub or small tree from Eastern Asia (*Illicium anisatum*), of the Magnolia family. It has small, but beautiful, fragrant blossoms, in terminal cymes and oblong leaves, which emit, when bruised, the odor of anise. The fruit is a brown capsule, like a star, commonly eight pointed, each ray being a follicle, opening at the top, and enclosing an oval, glossy brown seed. These seeds yield an aromatic oil, which is carminative and stimulative, and although sometimes used therapeutically, is chiefly employed for flavoring foods and liqueurs, having a sweet taste and odor more like fennel than anise. The fruits are burned as incense in the temples of Japan, where the tree is a great favorite with the native gardeners. It is also cultivated in Florida.

STAR-APPLE, the fruit of *Chrysophyllum cainito*, a sapotaceous tropical tree, native to the West Indies. It is about 25 feet high, very ornamental, and has slender branches and very beautiful foliage, the leaves being clothed beneath with golden-yellow hairs. The fruits are berries, about the size and shape of an apple, and vari-colored, white, green, yellow, rose-colored, or purple; it contains a pulp with a pleasant flavor, but unless perfectly ripe is astringent and leaves an intense acridity in the mouth which is difficult to remove. In the centre are eight or 10 cells, each containing a shining brown seed. When cut across, while immature, these cells form a many pointed star in the centre of the fruit.

STAR OF BETHLEHEM, stated in the New Testament to have appeared in the sky at the time of the birth of Christ. At various times since the appearance of Tycho Brahe's star in the constellation Cassiopeia in 1572, the celebrated Nova of that year, it has been suggested that this might be a variable star of long period, though there is nothing now in the vicinity of the place of this star brighter than the 12th of 13 magnitude. Nevertheless, a reported appearance of a bright star in somewhere near that part of the heavens about the middle of the 13th century combined with a more vague account of some similar appearance a little more than 300 years earlier, furnished material for conjecture that these might possibly be former appearances of the star of 1572, giving a period of about 310 or 315 years, which would carry it back three periods more to about the time of the birth of Christ. But as bright stars flame up occasionally, apparently from the collision of dead worlds, there is no scientific reason for doubting the existence of one at this time; although the idea that it stopped over the stable where the infant Jesus lay must have existed in the imagination of the beholders.

STAR OF BETHLEHEM, a liliaceous herb of the genus *Ornithogalum*, the flowers of which are fancied to resemble the star which located the place of Jesus' birth. The species are natives of the Old World, but two have escaped from gardens and become naturalized in America, especially *O. umbellatum*. It is low, with narrow leaves (the midrib being lighter in tone), which spring from a coated bulb, the flowers are arranged in the plan of threes, and are corymbose and borne on slender, bracted scapes in late spring. The six perianth-segments are nearly equal and separate, and open only in sunshine, the outside of each being pale green with white edges, while the inside of all is pure white. The small bulbs have been eaten in Palestine. Among other species of *Ornithogalum*, is the *O. caudatum* from the Cape of Good Hope, sometimes called onion-lily. Its leaves dry into long tails and its watery bulbs have great vitality unless exposed to severe cold. The satin-flower is the hardy *O. nutans*, with nodding green, white-lined blossoms, and, like *O narbonense*, remarkable for its height (three feet), is a hardy garden bulb.

STAR OF BOKHARA, Order of. See ORDERS (ROYAL) AND DECORATIONS.

STAR-CHAMBER, formerly an English court of civil and criminal jurisdiction at Westminister. It consisted originally of a committee of the Privy Council and was remodeled during the reign of Henry VII, when it consisted of four high officers of state, with power to add to their number a bishop, and a temporal lord of the council, and two justices of the courts of Westminster. It had jurisdiction of forgery, perjury, riots, maintenance, fraud, libel, and conspiracy, and could inflict any punishment short of death. Its process was summary and often iniquitous (especially in the reigns of James I and Charles I), and the punishments it inflicted often arbitrary and cruel. Jurors were punished for finding verdicts against the Crown. It approximated the methods of the Spanish Inquisition, sending for persons, enforcing confessions, and in some instances employing the torture. The excesses of this court brought about its own extinction, for it was abolished by Parliament in 1640. In the modern usage of the term a star-chamber is any secret session of a legislative body, council, board or other organization. In the United States Senate, a star-chamber session is called an executive session.

STAR-GRASS, a name given to several kinds of plants that have star-shaped flowers. Among the ones most widely known in America is the *Hypoxis hirsuta*, a small herb belonging to the Amaryllis family, with a corm or short root-stock, grass-like leaves springing from it, and a slender hairy scape, bearing several stellate three-merous flowers. These are bright yellow, and there are six narrow segments of the perianth, hairy on the outside, and widely spread. One of the lily tribe is the *Aletris farinosa*, a perennial herb; with tuberous rhizomes and bitter fibrous roots, which have been used as a domestic remedy, for intermittent fevers and for colic; whence its other name «colic root.» It is often found in sandy soil, its smooth, lanceolate leaves lying on the ground in a flat rosette, from which arises a tall, stiff stem, terete, and sometimes three feet high, with narrow bract-like leaves. It is crowned by a virgate, spike-like raceme of bell-shaped white flowers, just touched with yellow, and having an appearance of crinkliness like crêpe, and as if covered with a rough powder externally. The water star-grass is an aquatic plant (*Heteranthera dubia*) of the pickerel-weed family, its slender forked stems, and grassy floating leaves being found in still water. The flowers are arranged on the plan of threes, and their primrose-colored, stellate rays are widely separated, narrow and acute.

STAR OF INDIA, Order of. See Orders (Royal) and Decorations.

STAR OF THE OCEAN, Order of. See Orders (Royal) — *Hawaii*.

STAR QUARTZ, a variety of vitreous quartz, containing thin layers of a foreign substance, which produce the phenomenon of asterism in transverse sections of a crystal when cut en cabochon. Good material of this character has been found in Canada.

STAR OF RUMANIA, Order of. See Orders (Royal) and Decorations.

STAR SAPPHIRE, a variety of the mineral corundum which exhibits a six-rayed star in transverse sections of a crystal when cut en cabochon. This «asterism» appears to be due to reflections from the surfaces of twinning lamellæ. Fine star sapphires come from Ceylon and are prized as gems. Star Ruby is the ruby-red asteriated sapphire.

STAR OF SEVILLE, The (‘La Estrella de Sevilla’), known also as ‘Sancho Ortiz de Roelas,’ the title of a successful adaptation by Trigueros (1802), is commonly attributed to Lope de Vega (1562–1635), but is of doubtful authorship. One scene contains a reference to Vélez de Guevara's ‘El Diablo Cojuelo’ first published in 1641. Menéndez y Pelayo believed that the play was originally composed by Lope de Vega, but was rewritten by Claramonte, a contemporary actor and playwright. The oldest edition known is undated, but belongs apparently to the middle of the 17th century. The text is corrupt and often obscure, so that a critical edition is much needed. It is curious to note that a reprint was published in Boston, 1828, by George Ticknor's Spanish teacher, F. Sales, and is the first Spanish play printed in the United States.

‘La Estrella de Sevilla’ is a tragedy, and observes the unities of time and place, peculiarities which give the play distinction in the history of the Spanish drama. It is acknowledged to be a work of unusual beauty, vigorous composition, clear characterization, and intense dramatic interest. The scene is laid vaguely in the stern times of the reconquest, when Spain was engaged in border warfare with the Moors. The dramatist had no historical foundation for the ignoble rôle played by King Sancho the Brave. His object was to depict the stern, unbending honor of Sevillan nobles of a dim past when there was no compromise with duty and honor toward a king, however base and unworthy. But with consummate skill the author represents inflexible justice, personified in the firm and incorruptible magistrates of Seville, as victorious over the iniquitous monarch. Viewed in this light, the morality of the play, which critics have impugned, is vindicated. The resemblance to Corneille's ‘Le Cid,’ based upon a Spanish original, has often been noted. In striking contrast with Chimène, Estrella retires to a convent rather than accept a lover who, at the request of the king, has murdered her brother. There is probably no ground for the contention that the play contains veiled references to the tragedy that befell Juan de Escobedo at the command of Philip II. Consult ‘Obras de Lope de Vega’ (ed. Menéndez y Pelayo, Vol., XI). Lord Holland's translation of fragments will be found in ‘Some Account of the Life and Writings of Lope Felix de Vega Carpie’ (London, 1806).

Milton A. Buchanan.

STAR-SPANGLED BANNER, The, a patriotic song composed by Francis Scott Key 14 Sept. 1814, and now recognized throughout the United States as the national anthem, although it is not such in legal fact, Congress having repeatedly rejected proposals — one as recently as 1914 — to make a declaration to that effect by resolution. Nearly 100 years after it was written the song was prescribed by formal orders to be played in the army and navy on occasions of ceremony, and that is the extent of its official recognition to-day. Foreigners have long believed ‘The Star-Spangled Banner’ to be the fully accepted national anthem of America, and in their armies and navies, and on all public occasions when it is desired to honor America in music abroad, the familiar air is played. While many on this side of the water were inclined for many years to discredit the song and to advocate strenuously the claims of ‘My Country Tis of Thee,’ ‘The Battle Hymn of the Republic,’ and even ‘Yankee Doodle’ and ‘Dixie,’ the standing of ‘The Star-Spangled Banner’ was never disputed in other lands.

Even as late as the Spanish War of 1898 the ‘Star-Spangled Banner’ had only limited popular recognition and the general disposition at that period, at least in New England, was to elevate ‘My Country, Tis of Thee,’ to the place of honor. Marching troops in Cuba and Porto Rico, as all the world knows, were partial to ‘There'll Be a Hot Time in the Old Town To-night.’ In the Civil War, ‘John Brown's Body’ and ‘Yankee Doodle,’ on one side, and ‘Dixie’ and ‘The Girl I Left Behind Me,’ on the other side, were the favorite inspirations of the stalwart men who clashed on a hundred bloody fields. During the War with Germany in 1917–18 debate and difference on the subject of whether we have a pre-eminently preferred national anthem and what that anthem is vanished altogether. The National Star-Spangled Banner Commission laid the groundwork for the change. This commission was organized in Baltimore for the purpose of preparing the centennial celebration of Key's song in September 1914 and for many months before that it conducted an active and widespread propaganda. Patriotic organizations, such as the Sons of the Revolution, the Society of the War of 1812, and others, co-operated with enthusiasm and did much to develop public opinion. No other candidate for acceptance as the national anthem had this systematic and vigorous backing, and no other writer of an American patriotic song has had so many honors paid to him as Key, for whom Congress has erected an imposing sculptured memorial in Fort McHenry and whose lineaments are preserved in public statuary as far from the scene of his labors as San Francisco. The incidence of war so soon after this propaganda caused it to have a maximum effect.

'The Star-Spangled Banner' was composed by one of the best of the American types. Key was poet, scholar, lawyer, public official and churchman, and member of a distinguished family. He wrote 'The Star-Spangled Banner' in a burst of inspiration. It was written in a moment of acute national stress and expressed, as it does still, the characteristic feelings of the country — not desiring to provoke war, but rising with determination to take arms in defense of the national honor when a crisis required it. In literary form it is far superior to most patriotic songs, and even without the music would find wide popularity on its merits as a poetical composition.

It struck the popular fancy at first and has held it in large measure ever since. Key had the words printed in hand-bill form in the office of *The Baltimore American*, and distributed on the streets of the delivered city in September 1814, before the British fleet which had been beaten off from Fort McHenry had gotten out of the Chesapeake. It was sung on the stage of the famous Holliday Street Theatre in Baltimore and taken up with intense eagerness by the people there and throughout the nation. Few incidents in our national history have been beclouded by so much misconception of fact as the origin of this anthem. The most common error, which has had an unfortunate habit of creeping into print, is that Key composed the words while he was a prisoner of war on the British fleet which attacked Fort McHenry. Key was not a prisoner of war, but had gone to the fleet on the cartel ship *Minden*, used by the American government in negotiating exchanges of prisoners, for the purpose of obtaining the release of a civilian, Dr. William Beanes of Upper Marlborough, Md., who was being detained because he had caused the arrest of British marauders. As Key reached the fleet, when the attack on Baltimore was about to begin, he was kept behind the British lines until it was over in order that he might not convey information of the impending movement. He was treated with the utmost consideration and was promptly released when the attack ended. When he was rowed ashore on the morning after the bombardment he had in his pocket, scribbled on the back of an old letter, the draft of the song which has become so famous since. The original manuscript is owned by Henry Walters, owner of the Walters Art Gallery. The flag whose "broad stripes and bright stars" burst upon Key's enraptured vision on that September morning of 1814 is preserved in the National Museum at Washington, D. C.

The words of the song follow:

THE STAR-SPANGLED BANNER.

Oh! say can you see by the dawn's early light,
What so proudly we hail'd at the twilight's last gleaming,
Whose broad stripes and bright stars through the perilous fight,
O'er the ramparts we watched were so gallantly streaming?
And the rocket's red glare, and bombs bursting in air,
Gave proof through the night that our flag was still there!
Oh! say, does the star-spangled banner yet wave
O'er the land of the free and the home of the brave?

On the shore dimly seen through the mist of the deep,
Where the foe's haughty host in dread silence reposes,
What is that which the breeze o'er the towering steep,
As it fitfully blows, half conceals, half discloses?
Now it catches the gleam of the morning's first beam,
In full glory reflected, now shines in the stream;
'Tis the star-spangled banner. Oh! long may it wave
O'er the land of the free and the home of the brave.

And where is *that band* who so vauntingly swore,
'*Mid* the havoc of war and the battle's confusion,
A home and a country *they'd* leave us no more?
Their blood has washed out their foul footsteps' pollution;
No refuge could save the hireling and slave
From the terror of flight, or the gloom of the grave,
And the star-spangled banner in triumph shall wave
O'er the land of the free and the home of the brave.

Oh! thus be it ever, when freemen shall stand,
Between their loved home and war's desolation;
Blest with victory and peace, may the Heaven-rescued land
Praise the power that made and preserved us a nation.
And conquer we must, when our cause it is just,
And this be our motto, "In God is our trust."
And the star-spangled banner in triumph shall wave
O'er the land of the free and the home of the brave.

STAR-THISTLE, one of the European plants of the genus *Centaurea* (q.v.). They are not true thistles, but are closely allied composites. *C. calcitrapa* is an annual, much branched, and spreading weed sparingly naturalized in America. It has one to two-pinnatifid, serrulate, spiny leaves, the upper one sessile and clasping. The flowerheads are purple, small and rayless, and have an ovoid receptacle surrounded by ovate involucral bracts, the outer being long and spreading, and tipped with stout spines. The common name is said to be derived from a fancied resemblance of the spiny involucre of the yellow flowered star-thistle (*C. solstitialis*), to the weapon called "morning-star," an iron ball with short spikes.

STAR OF THE WEST. At sunset 5 Jan. 1861, the merchant steam-vessel *Star of the West* sailed from New York to supply and reinforce Major Robert Anderson, at Fort Sumter, Charleston Harbor. She was commanded by Capt. John McGowan, was unarmed, and carried a large quantity of supplies for Anderson, as well as Lieut. C. R. Woods, United States army, with four officers and 200 artillery recruits. She reached the outer bar of Charleston Harbor before daylight 9 January and as the harbor lights were out, put out her own and groped in the dark until nearly daylight, when, guided by the light on Fort Sumter, she stood in. The South Carolina authorities had been notified of her coming by Secretary Thompson of President Buchanan's Cabinet, and a vessel was lying off the main channel watching for her, and when she was seen gave signal-lights of warning to the Confederates on Morris Island, and then ran up the harbor, the *Star of the West* following, as soon as it was light, and steaming up the main channel for Fort Sumter. She flew the United States ensign at the fore and went on without interruption until within one and three-quarters miles of Forts Sumter and Moultrie, when she was fired upon by a battery near the north end of Morris Island and about five-eighths mile distant. She ran up a garrison flag, to which no attention was paid, save to increase the rapidity of the Confederate fire, which was kept up on her from Morris Island, with an occasional shot from Fort Moultrie. McGowan was powerless to defend himself, and no assistance came from the guns of Fort Sumter, as Major Anderson had not been notified of this expedition for his relief. Therefore McGowan turned his vessel seaward, after 17 shots had been fired at it, two of which had struck it, and returned to New York on 12 January. This firing on the flag of the United States was the first overt act in the Civil War. At the South there was great exultation that the flag of the Union had been insulted; at the North it produced but little excitement. Consult 'Official Records' (Vol. 1).

STARA-ZAGORA, Bulgaria (Turkish name ESKI-ZAGRA), a town in Eastern Rumelia, capital of the department of the same name, 45 miles south of Tirnova, at the foot hills of the Balkans. Rose oil is the town's principal industry. It has also mineral springs and its commerce is helped by its location at the junction of the principal passes of the Balkan Range. In the neighborhood, in July 1877 the Russians were defeated by the Turks under the command of Suleiman Pasha. Pop. about 22,000.

STARCH, a proximate principle exclusively of the vegetable kingdom with the formula $n\ C_{12}H_{20}O_{10}$. The value of n has not been determined but all experiments go to show that it is large — not less than 100, and that, therefore, the molecular weight of starch is at least 32,400. It is found in almost every plant at some period of its life-history, and is especially abundant in wheat, potatoes, arrowroot and other similar kinds of vegetation, and forms a very large and important part of the food of man and the herbivorous animals. It occurs in the ovule of the seed, in the cotyledons of the embyro, in the pith, the bulbs, stems and notably in the roots and tubers of certain families of plants, as the potato, sweet potato, cassava, etc. The starch granules are found in the growing plant in the protoplasm of the chlorophyll corpuscles, varying according to the time of day, being in greatest numbers toward evening and fewest in the morning, sometimes disappearing entirely during the night. Appearing at first as simple points, they gradually increase in size, so that eventually they fill completely the chlorophyll corpuscle, the latter appearing as simply an envelope for the starch. The starch granules grow and increase in size only when in contact with protoplasm and under conditions of exposure to light at a favorable temperature and in the presence of carbon dioxide. These granules are of widely varying sizes in different plants, ranging from a diameter of 0.0069 inch in the canna and 0.0055 inch in the potato, to 0.0003 inch in the parsnip and 0.0002 in the seeds of the beet. Starch appears to be formed in plants in greatest quantity when there is a large supply of nutriment, and it disappears when the nutriment becomes deficient. The amount of starch in various alimentary substances is exhibited in the table following.

Name of substance	Starch in 100 parts
Haricot-bean flour	99.96
Haricot-beans	37.7
Wheat-flour	57 to 67
Rye-flour	54 to 61
Oats	30 to 40
Barley-flour	64
Barley	38 to 42
Rice	75 to 77
Buckwheat	44
Indian corn	65 to 66
Corn-starch	77 to 78
Potatoes (air-dried)	16 to 23

Starch is a soft, white, shining powder, insoluble in cold water, alcohol or ether; under the microscope it is seen to consist of granules, each of which is formed of a series of stratified envelopes concentrically arranged round a common nucleus, the outer ones being the denser. Inasmuch as these layers or envelopes are of variable thickness they cause the granule to assume more or less a flattened ovoid form. Occasionally there are two nuclei within the outer envelope, each surrounded with its own series of concentric layers. The outer layer is the first formed and is known as "starch cellulose"; the interior is called "granulose." These two substances may be separated by appropriate chemical action. Starch dried at ordinary temperatures always retains an amount of water varying from 12 to 18 per cent; but by drying in a vacuum over sulphuric acid and gradually raising the temperature to 212° F. it may be obtained perfectly free from water; but if it be boiled with water the starch granules are swollen and broken up, so that on cooling, a stiff, gelatinous mass, starch-paste, is produced; on largely diluting this paste with water, the swollen granules for the most part subside, but a considerable quantity of starch remains in solution. By boiling starch mixed with a quantity of water, under pressure, at a temperature of about 300° F., it is mostly dissolved, and on filtering the liquid and allowing it to cool small granules of starch are deposited, which are slightly soluble in cold water, and are at once dissolved by water heated to 160°. This modification of starch is known as soluble starch. The simplest method of making soluble starch is to dissolve it in hot glycerine. Starch may be detected by boiling the suspected substance with water, cooling and adding tincture of iodine, when, if starch be present, a fine deep blue color is produced; this color is dissipated by heat or by substances such as alcohol, ether, etc., which dissolve and so remove the iodine.

Nitric acid acts on starch in different ways, according to the strength of the acid used and the temperature. Cold concentrated nitric acid forms a substitution product, in which one hydrogen atom of the starch is replaced by the group NO_2. A mixture of concentrated nitric and sulphuric acid gives rise to the formation of a dinitro-substitution product, in which two atoms of hydrogen are replaced by the group NO_2 twice. Hot nitric acid converts starch into oxalic, malic and acetic acids. Acted upon for 24 hours by a 12 per cent solution of hydrochloric acid, the starch becomes soluble in water without forming a paste.

Preparation of Starch.— With regard to the purposes to which starch is applied, the various kinds may be divided into (1) starches used for food and (2) starches used for laundry and other industrial purposes, though certain kinds are extensively used under both of these heads. In their chemical relations all varieties of starch are identical, but in their physical constitution and microscopic structure they present marked differences, and they also vary much as regards digestibility and suitableness as articles of food. The size of these granules and the arrangement of layers differ in every different species of plant, and, therefore, the source of any particular starch is readily determined by microscopic examination. Starch may be purified by freezing a 1 per cent mixture with water and melting the ice. The starch settles and the liquid retains the impurities.

The food starches embrace arrowroot, tous-lesmois, sago and tapioca. Corn-starch, which has an enormous sale, is simply the starch of Indian corn or maize separated mechanically from the grain. The process most commonly in use in the United States is known as the sulphur dioxide process. The grain is steeped in a 1 per cent aqueous solution of sulphur dioxide at a temperature of 250° to 300° F. for from two to four days. The swelled grains while wet are then crushed between cylinders under a flow of water, washing the mass through a cylindrical sieve so as to separate out the husky matter. The milk-like fluid which contains the starch in suspension passes through the sieve and is run along a series of gently inclined surfaces, on which the heavier granules are deposited, the lighter and finer particles being carried with nitrogenous matter into settling-tanks. The deposit which accumulates in the settling-tank is purified by repeated straining and settling, and the separated starch is dried by gentle artificial heat, when it crumbles to a powder, and as such it is packed for the market.

Starch for industrial purposes is obtained also from potatoes, wheat and rice, and sago starch is extensively employed for other than food purposes. Starch from many different substances finds occasional or limited employment. Potatoes affected by disease yield as pure and useful a starch as sound tubers, but much less in proportion to their weight, as the disease usually results in the transmutation of starch to sugar. On a small scale the preparation of starch from potatoes is a simple operation. The tubers have simply to be thoroughly washed to free them from all earthy impurity, then rasped down to a fine pulp in a tub of water and allowed to settle, when the starch will fall to the bottom and the greater part of the skin or husk will float on the water. By repeated washing and settling of the starchy deposits the starch may be obtained in a condition of purity, and it may then be dried by gentle heat for preservation and use. On the manufacturing scale, machinery of various kinds is adapted for performing the several processes of steeping and washing, straining out of stones, rasping, straining, settling, purifying, draining and drying which the potatoes undergo. Some manufacturers pass the raspings through a grinding mill, resulting in an increase of starch product by 8 to 12 per cent. Beyond its use in industrial pursuits in common with other starches, potato-starch is much employed for making imitation sago, for adulterating and as a substitute for the more costly food-starches, for preparing starch-sugar and as a source of potato-spirit.

Wheat-starch is prepared by two distinct processes. By the first and old method the grain is subjected to a process of fermentation whereby the gluten or nitrogenous constituent of the wheat is rendered soluble and the remainder of it loses its adhesive property, and in this condition the starch is easily separated out by a washing wheel or drum. By this process the greater part of the gluten is wasted, and a smaller yield of starch is obtained than can be secured by the more recent system of Martin. The principle on which the latter proceeds can be easily illustrated by making a dough of flour, placing it in a muslin bag and squeezing it under the water, when the starch exudes mingling with the water and settling as a sediment, leaving within the muslin a gray semi-elastic mass consisting chiefly of gluten. In this way the gluten is saved and can be utilized for cattle-feeding, etc. The production is two pounds of starch for each pound of gluten. By whatever process prepared, wheaten starch is purified by repeated washing and settling, and dried by gentle heat, and on drying it assumes the columnar structure by which it is familiarly known.

In the preparation of rice-starch, a variety preferred for laundry purposes, the grain has to be steeped in a slightly alkaline solution on account of its peculiarly hard and horny envelope of gluten. In addition to being extensively used in laundries, starch is largely consumed in the manufacture of dextrin (q.v.), and it is also employed as a thickener in calico-printing, and in the finishing of bleached and printed calicoes. Placed in a 2 per cent solution of soda or potash the granules swell, forming a tenacious paste used by photographers for mounting prints and for many other purposes. Dry starch finds a valuable minor adaptation in dusting molds in metal-casting, besides being applied for many miscellaneous purposes.

Statistics.— In the United States in 1914 there were 82 starch factories, having an invested capital of $12,070,000. There were 1,780 persons employed and the total value of the product for the year was $13,996,000. In this production New York ranked first, Indiana second and Ohio third. The total quantity of starch manufactured was 620,764,347 pounds. Of this total, 574,247,697 pounds were made from Indian corn, 23,540,472 pounds from potatoes and 22,976,178 pounds from all other materials. A very large quantity of starch was made by the seven glucose factories previous to its conversion into glucose (q.v.). No account is made of this in the figures given, as the product did not appear in the markets as starch.

STARFISH, any echinoderm of the group *Asteroidea* (see ECHINODERMATA), in which a pentagonal disc forms the central body, whence radiate five or more pointed arms, containing prolongations of the stomach, as well as digestive glands, reproductive organs, etc. The mouth is on the inferior surface of the disc and the vent (when one exists) is on the upper surface. The exoskeleton consists of a mosaic of limy plates united and covered by a leathery, usually reddish-brown skin, forming a pliant armor. The plates of the disc are similar to those of the "cup" of crinoids (q.v.) and similar echinoderms. Those of the arms form along the floor a groove carrying the ambulacral water-vessels and tube-feet. The exterior of the plates, except in the ambulacral grooves, is studded with tubercles, each bearing a spine, giving the starfish a generally spiny appearance. Studding the skin among the spines are numerous branchial papillæ and the usually three-jawed, flexible-stalked pedicellariæ, which continually bend about and by their snapping pick up and remove accumulated waste matter from the respiratory surface of the animal. So independently do they act that for many years they were considered to be parasites. The alimentary canal is simple, with a pair of large cæcal digestive glands reaching into each arm. (The nervous, blood and water-vascular systems conform to the plan described in the article ECHINODERMATA). Distinct eye-spots are present at the tips of the rays in most species, the large orange-colored spot which is popularly called the «eye» of the starfish being in reality the madreporic plate, by means of which water is admitted to the ambulacral system. In starfishes the sexes are usually separated and the eggs fertilized in the water. Development takes place with a metamorphosis, the larval stage being free-swimming, provided with ciliated bands and processes, and known as the bipinnaria. The body of the young starfish forms within the body of the larva, only a small portion of which develops directly into the starfish, the remainder being simply absorbed to nourish it.

Locomotion is accomplished by means of the thousands of tube-feet arranged in double rows on the under side of each arm. These successively extend, attach themselves, contract, let go and reach forward again, hundreds acting together to draw the body slowly but continuously onward. The individual feet are extended by means of water forced into them by the contraction of the ampullæ, with which each is provided, and contracted by their own musculature, which forces the water back into the now relaxed ampulla, the supply of water in any part being regulated through the madreporic plate and the system of canals and polian vesicles. Besides the sexual mode of reproduction starfishes possess the power of regenerating lost parts developed to so great a degree that it amounts to a sexual reproduction. When handled or injured they will often automatically cast off an arm or even all of the arms close to the base. Not only will the disc regenerate any number or all of its arms when lost, but in some cases the single arms will develop new discs, thus producing several individuals from one. Experimental cuttings of starfishes has shown how bifurcated or extra arms may be produced. As their only natural enemies are bottom-feeding fishes of the cod family, and as it seems probable that one or more arms could thus often escape capture, this capacity for regeneration (q.v.), combined with their tenacity of life and enormous fecundity, probably accounts for the surpassing numbers in which they sometimes occur.

All starfishes are marine and most of them live in comparatively shallow water, though a few extend to great and many to moderate depths. As fossils they occur in most formations from the Cambrian upward, but are much less numerous than the sea-urchins, being less well adapted by their structure for preservation. While the number of arms is generally five, or some multiple of five, some genera bear irregular numbers as 13 in *Solaster*, 9 to 13 in *Brisingo*, or upward of 20 in *Heliaster*, while a few, as *Culcita* and *Asteriscus*, are pentagonal and nearly without trace of arms.

Starfishes are voracious creatures which feed for the most part upon mollusks, including such large bivalves as oysters. The manner in which they accomplish this apparently impossible feat is very remarkable. By means of the suckers at the ends of the tube-feet the starfish attaches part of its arms to each valve of the oyster and by a steady continuous traction sooner or later so weakens the adductor muscle of the latter that the valves gape open. As the mouth is too small to admit the body of the oyster the stomach is protruded and, enwrapping its prey, the soft body is gradually sucked through the mouth. Small gastropods may be taken into the mouth entire. Many species of starfishes lives on the bottom in vast shoals, and, although sluggish creatures, they often migrate to new feeding grounds, moving over the ground steadily in a definite direction.

The best-known starfishes of our Atlantic shores are the *Asteracanthion vulgaris* and *A. forbesii*, the former chiefly north, the latter south of Cape Cod, though both are found in Vineyard Sound and the neighboring waters. They are nearly alike, reach a diameter of 12 or 15 inches and extend from low water to considerable depths. Both species congregate in great numbers on mussel and oyster beds, often committing great havoc on the latter. They are removed from the latter by the boatload by means of dredges and tangles and cast ashore. Formerly the oystermen broke them into pieces, which were cast into the water in expectation of killing them, with the result that their numbers were increased greatly. The smooth starfish (*Cribrella sanguinolenta*) is a very pretty, small, shallow water species with five long, round, nearly smooth arms and a color which varies from purple to yellow and pink. It is most abundant north of Cape Cod and is remarkable in utilizing the sides of the mouth as a brood pouch in which the young are carried. *Echinaster sentus* is a related southern species with rough spinous arms. *Croosaster pappossus* is common in a few fathoms of water on the New England coast. It has a very broad body disc and flattish arms, which vary from 12 to 15 in number. *Luidia clathrata* and *Astropecien articularis* are flat, very brittle, five rayed starfishes with the upper surface very densely covered with small spines and the arms margined with large plates and a fringe of spines. Both occur on the south Atlantic coasts, occasionally as far north as New Jersey. Many interesting species are dredged in deeper water or are sometimes thrown ashore during storms, and others occur in the Gulf of Mexico in shallow as well as deep water. One of these is the massive, heavily-armored, rigid *Pentaceros reticularis*, the species commonly sold in shell shops at the seaside resorts and the largest starfish of the Atlantic Coast. The Pacific Coast fauna is much richer and more varied, among the species being the gigantic *Asterias giganteus*, over two feet in diameter and six-rayed, the 10-rayed *Solaster decemradiata*, the flat, granulated, bright-red *Mediaster æqualis*, the thick, flat, pentagonal, great-spined *Nidorella armata*, and the nearly armless and very small *Asterina miniata*. Consult Agassiz, 'North American Star-fishes,' Memoirs Museum of Comparative Zoology (Cambridge 1877);

Slader, ‘Asteroidea of the Challenger Expedition’ (London 1889); Lankester, ‘Treatise on Zoology’ (Pt. III, London 1900); Lockington, ‘Standard Natural History’ (Vol. I, Boston 1884).

J. Percy Moore,
University of Pennsylvania.

STARGARD, stär'gärt, a town in Pomerania, Prussia, 21 miles southeast of Stettin, on the Ihna River. It consists of three parts, the main town and two suburbs. It was formerly a fortified town; but of the ancient walls only the gates remain, the rest having been replaced by promenades. There is a monument commemorating the Franco-Prussian War. The buildings deserving notice are the old townhouse, churches, gymnasium and orphan asylum. Stargard has a law court and government offices, there is a brisk trade in agricultural produce, iron foundries, machine-shops, soap and oil factories, distilleries and roofing factories.

STARK, John, American soldier: b. Londonderry, N. H., 28 Aug. 1728; d. Manchester, N. H., 8 May 1822. In 1755 he became a lieutenant in Major Rogers' rangers and fought through the French and Indian struggles around Lakes George and Champlain. In 1775 he joined the Continental army, was appointed colonel and fought at Bunker Hill and later at Princeton and Trenton. After the retreat of General St. Clair and the capture of Ticonderoga by the British, Stark was put in command of a force of "Green Mountain boys," that met and defeated an English detachment under Baum at Bennington 16 Aug. 1777. A supporting British force under Breymann was also defeated. These events paralyzed the British operations and led to the surrender of Burgoyne at Saratoga. He was promoted brigadier-general, and continued in active service until the end of the war. Consult Everett, E., ‘John Stark’ (New York 1902); Stark, C., ‘Memoir and Official Correspondence’ (Concord, N. H., 1860).

STARKEY, stär'kĭ, **Thomas Alfred,** American Protestant Episcopal bishop: b. Philadelphia, Pa., 1819; d. East Orange, N. J., 17 May 1903. He was educated as a civil engineer and engaged in that profession in 1839–45, after which he studied theology and in 1848 he was ordained to the priesthood. He was rector of Christ Church, Troy, N. Y., in 1850–54, of Saint Paul's, Albany, N. Y., in 1854–58, of Trinity Church, Cleveland, Ohio, in 1858–69 and was in charge of the church of the Epiphany, Washington, D. C., in 1869–72. He was called to Saint Paul's Church, Paterson, N. J., in 1877 and in 1880 he was consecrated bishop of northern New Jersey.

STARKEY, Thomas Albert, Canadian physician and bacteriologist: b. Cheshire, England, 1872. He was graduated in medicine at the University of London in 1894, and later spent some time in the London hospitals. He was for a number of years engaged in research work in India, seeking methods for the prevention and cure of cholera. He was engaged at the Imperial Research Laboratory, Bombay, in 1899–1901, and afterward superintended the sanitary work in the districts of Satara and Poona, India. He was bacteriologist to the London county council on his return to England, and in 1902 accepted the chair of hygiene at McGill University. He became a member of the Royal Sanitary Institute, London, in 1906; and in 1910 was elected the first president of the Canada Public Health Association. He is author of many papers and reports on his specialties.

STARKVILLE, Miss., city and county-seat of Oktibbeha County, 115 miles northeast of Jackson, on the Illinois Central and the Mobile and Ohio railroads. The Mississippi Agricultural College is located here. There are stock-raising, cotton and lumber interests, and cotton and cottonseed-oil mills. Pop. 2,698.

STARLING, a field-bird of the family *Sturnidæ*, known by the compressed sharp bill, the long and pointed wings and the short tail. The tarsi are stout and covered in front with broad scales. The toes are also elongated and strong, the hinder toe being largely developed. The common starling (*Sturnus vulgaris*) is a well-known European bird, commonly seen in large flocks, particularly in marshy districts. The general color is dark green, tinted with purple hues, and with metallic lustres. The shoulders are brown or buff, the wing-coverts edged with pale brown and the general plumage spotted with buff. The breast feathers are elongated and pointed; the beak is yellow. In the second year of life the characteristic colors consist of the adult colors just described, these, however, being of generally lighter hue, whilst the general surface is marked with light-colored spots. The first year's birds are brown. The females are less brilliantly colored than the males. The nest is loosely constructed, and is generally found in some ruined wall or castle, or in a hollow tree. The five eggs are pale blue. The young are tended by both parents. The food of the starling consists of insects, and these birds haunt domestic animals to get the insects that prey upon them. They often perch on the backs of cattle in search of the insect larvæ that burrow in the skin; and pluck wool from sheep for the purpose of lining the nest. They also eat mollusks, worms and vegetable matters, and they have been known to strip whole shrubberies of their leaves. The common starling is found throughout Europe, Africa and most of Asia, and is migratory. Starlings are viewed with great favor in many districts, are caught to be kept in cages, and may be taught to speak, to mimic sounds with great distinctness and to whistle tunes. Their natural note is a peculiar, indrawn, clear and pleasing whistle. They have been acclimatized in the neighborhood of New York, where they were introduced in 1890; since which time they have spread over most of the Northeastern States. Various more or less similar or related birds are called starlings in India and Australia. Consult Forbush, E. H., ‘The Starling’ (in *Massachusetts State Board of Agriculture* 58th annual report, Boston 1915); Leydekker, R., ‘Standard Natural History’ (London 1895); Newton, ‘Dictionary of Birds’ (New York 1896).

STARNINA, Gherardo, gä-rär'dō stär-nē'nä, Italian painter: b. Florence, 1354; d. 1407. He was a pupil of Antonio Veneziano. After painting the history of Saint Nicholas and Saint Anthony, on the ceiling of the Castellani Chapel in Santa Croce, he was forced for political reasons to take refuge in Spain. There he worked for the king and others, returning to Italy with considerable wealth (1387). He made many frescoes but little of his work remains save the 'Death of Saint Jerome' in the church of Santa Maria del Carmine.

STARNOSED MOLE. See MOLE.

STAROVERTZ. See RELIGIOUS SECTS.

STARR, stär, **Frederick,** American anthropologist: b. Auburn, N. Y., 2 Sept. 1858. He was graduated at Lafayette College in 1882 and from 1889–91 was in charge of the department of anthropology at the American Museum of Natural History; in 1888–89 was registrar of Chautauqua University; 1892–95 was assistant professor, and since associate professor of anthropology in the University of Chicago. Later he traveled extensively, making special studies in anthropology and ethnography, in Mexico; in Central Africa, 1905–06; in the Philippines 1908; in Japan, 1909–10; and in Korea, 1911. He published 'First Steps in Human Progress' (1895); 'American Indians' (1899); 'Indians of Southern Mexico' (1899); 'Strange People' (1900); 'The Ainu Group at the Saint Louis Exposition' (1904); 'The Truth About the Congo' (1907); 'In Indian Mexico' (1908); 'Filipino Riddles' (1909); 'Japanese Proverbs and Pictures' (1910); 'Congo Natives' (1912); 'Liberia' (1913); 'Mexico and the United States' (1914).

STARR, Moses Allen, American neurologist: b. Brooklyn, N. Y., 16 May 1854. He was graduated at Princeton University in 1876 and received his medical degree from Columbia University in 1880. He became editor of the *Psychological Review and Journal of Nervous and Mental Diseases,* and published 'Familiar Forms of Nervous Disease' (1893); 'Brain Surgery' (1895); 'Atlas of Nerve Cells' (1897) and lectures on 'Diseases of the Mind' (1898), and 'Diseases of the Nervous System' (1899); 'Nervous Diseases, Organic and Functional' (1913); besides numerous articles to medical journals and chapters to textbooks on mental and nervous diseases. He received from Princeton the degrees of Ph.D., 1884; LL.D., 1899, and from Columbia, Sc.D., 1904. At Columbia University he was lecturer, 1887–89; professor, 1889–1915 and since professor emeritus of neurology.

STARRY CROSS, Order of. See ORDERS (ROYAL) AND DECORATIONS.

STARS, a designation familiarly applied to all the heavenly bodies which look like points of light. This designation includes five of the planets, Mercury, Mars, Venus, Jupiter and Saturn. In scientific language the term is applied only to those bodies which seem fixed on the celestial sphere, and are, therefore, termed *fixed stars.* These are immense incandescent bodies, scattered through the immensities of space at distances which beggar all our conceptions. In accordance with the general plan of the present work, we begin with a study of the stars as they appear to us, and then pass to the consideration of their actual constitution and situation in space. We shall, therefore, suppose the reader to scan the heavens at night while we point out certain features of the scene of grandeur then presented to his vision.

The first feature to be noticed is the great diversity in the brightness of the stars, or, to use a technical expression, in their *magnitudes.* These range all the way from that of the brightest stars down to the point of invisibility to the naked eye. The smallest telescope will show scores of stars too faint to be seen without its aid, and the greater the power of the instrument the greater the number that will be brought into view, without any limit yet known.

The ancient astronomers divided the stars into six orders of magnitude, called the first, second, etc. The 15 or 20 brighter stars were classified as of the first magnitude, those a grade below them as of the second, and so on, until they came to the sixth, which comprised the faintest stars visible to the unaided eye. All these stars are now called *lucid;* fainter ones *telescopic.* In modern times the preceding system of magnitudes has not only been extended to the telescopic stars, but has been arranged on a plan which gives greater precision, and enables us to designate the exact measure of the light which we receive from a star by its magnitude. The magnitudes of stars are now designated to tenths, or, to give greater precision, even to hundredths of a magnitude. Thus we have stars of magnitudes 3.0, 3.1, 3.2, etc. These numbers are arranged on a diminishing scale of light, so that a difference of one magnitude corresponds to the multiplication or division of light by a number very near 2.5, or, more exactly, the number whose logarithm is 0.4. This means that a star of magnitude 3.0 is about two and a half times as bright as one of magnitude 4.0; this again about two and a half times as bright as one of magnitude 5.0, etc. The exact scale is such that a star of the first magnitude is precisely 100 times as bright as one of the sixth, while the latter is 100 times as bright as one of the 11th, so that an increase of five units in the scale of magnitude corresponds to a division of the light by 100.

Careful examination will also show that the stars of each magnitude are several times as numerous as those of the brighter magnitudes. There are three or four times as many stars of the fourth magnitude as of the third; three or four times as many of the fifth as of the fourth and so on in nearly geometrical progression. But when we pass to the stars invisible to the naked eye the progression is not so rapid. Yet its common ratio does not fall below two at any point yet known. The result is that the stars of the fainter magnitudes are to be counted by millions. The faintest stars visible in the largest telescopes are about of magnitude 17 or 18.

Another familiar feature of the sky is that the stars are not scattered uniformly, but that the brighter ones appear to be collected to a greater or less extent into constellations. There is, however, no precise dividing line between one constellation and another. The irregularity is such that the number of constellations is somewhat arbitrary. The fainter the stars the less marked is the division into constellations. The telescopic stars cannot be divided into constellations at all. See CONSTELLATIONS.

Careful observation shows that the stars differ slightly in color. It is true that the colors are less marked than those of natural objects, there being no such red as the ruby and no such bright green as the emerald among the stars. But there is a regular gradation from a yellowish red through white, to a well-marked, bluish tint. These differences of color are supposed to indicate different degrees of temperature of the stars, or different periods in their growth and development.

Number of Stars.— The whole number of stars in the heavens, visible to the naked eye, is about 5,000. As one-half of these are necessarily below the horizon at any one time, it follows that not more than 2,500 can be seen at once. But this is greater than the actual number visible under ordinary conditions, because small stars near the horizon are rendered dim or invisible by the thickness of the air through which we see them. Practically, it is not likely that more than 2,000 stars can ever be seen at once by the best eye, unless at elevated points where the air is very clear down to the horizon.

Up to the present time it has been impossible to make anything like an enumeration of the telescopic stars, because, as we have already said, every increase in the power of the telescope brings out new stars that otherwise would be invisible. There is, however, no doubt that the stars visible in a large telescope are to be counted by tens of millions. It is now found that stars can be photographed with a large telescope which are so small that the eye would not perceive them in the telescope itself. It is probable that the whole number found on the best photographic plates amounts to more than 100,000,000. But we must not suppose that this number would actually comprise all the stars in the sky. Although in some directions we seem to have reached the limit of the visible stars, we do not know, when the entire heavens is considered, how many fainter stars there may be for every one that can be photographed. A very recent estimate fixes the total number of the stars at 1,600,000,000, but this is as yet necessarily very uncertain.

The Milky Way.—Another feature of the sky connected with the stars is the Milky Way or Galaxy. This really stupendous though not striking object can be seen at some hour of any night in the year, its position in the sky depending on the season. In our latitudes it is quite near, partly below the horizon during the evenings of May, and is then not readily seen, but even then it may be seen later in the evening. At the proper time, on any night, it passes nearly through the zenith, spanning the heavens like a complete arch, resting on two opposite points of the horizon.

Galileo, pointing his first telescope to the sky, found that this object was composed of congeries of stars too faint to be separately visible. This fact has been abundantly proved by modern observations. A very little study of the sky without a telescope will show that the milky light of these stars is by no means uniform, but is frequently gathered into clouds. These show that the Milky Way is in part made up of vast groups or collections of stars, rather irregular in form. The aspect of the Milky Way is also very different in different parts of its course. One of its most remarkable features is best seen in summer and autumn. It will then be noticed that, in the region of the zenith, the Milky Way seems to be divided into two separate streams with a comparatively dark space between them. This seeming cleft extends toward the south, nearly to the celestial equator, where one of the streams branches off toward the west and comes to an end, while the other continues on its course. It will also be noticed that at some points of its course the Galaxy is narrow and well defined, while in others, notably in the extreme south, it is wide and diffuse.

Many astronomers have occupied themselves in making photographs of various portions of the Milky Way. Barnard has used a large camera for this purpose, and, in several observatories, the largest telescopes have been so employed. One curious feature is brought out by these photographs. In that part of the Milky Way which in autumn is seen between the celestial equator and the southern horizon, numerous clefts and vacant spaces occur, as though there were actual openings through the mass of stars. This fact seems to show that the thickness of the Milky Way, or the distance through which the line of sight extends when we look at it, is less here than elsewhere. Going farther south, into regions invisible in our northern latitudes, other vacant spaces are found, known as *coal-sacks*. But it is found that stars really exist in these spaces, though they are comparatively few and faint.

Another feature of the southern hemisphere comprises two patches of light called the Magellanic Clouds. These are situated at some distance from the Milky Way, and yet seem to be of the same general nature as the latter. They may be described as two outlying collections of very faint stars.

It is found by careful observation and count that the stars of any magnitude seem to be rather thicker in the region of the Galaxy than elsewhere. The smaller the stars the greater the thickness in and near the Galaxy becomes, so that it is probable that a large majority of the very faint stars belong to the Milky Way. Several other peculiarities connected with stars of the Milky Way will be better understood after we have described certain varying characteristics of the stars.

Naming the Stars.— Most of the brighter stars, not only those of the first and second magnitude, but a few remarkable ones of fainter magnitudes, had special names assigned to them in ancient and mediæval times. The oldest and best known of all these names is Arcturus, which is found in the book of Job. The names of Castor and Pollux were also assigned in classic antiquity to the two brightest stars in the constellation Gemini, or the Twins. But most of these special names are derived from designations given by the Arabs, which were supposed to express some peculiarity of the star. There are also quite modern names, *Polaris*, for example, which designates the Pole Star.

During the past three centuries most of these names have been, to a greater or less extent, replaced by a system of designating the brighter stars in all the constellations, which was introduced by Bayer about 1600. He assigned to the principal stars in each constellation the letters of the Greek alphabet, alpha, beta, gamma, etc. Commonly the first letter of the alphabet is assigned to the brightest star, and the progress of the letters indicates, to a certain extent, the successive orders of brightness in the same constellation. But this rule was not uniformly carried out; frequently the successive letters taken in alphabetical order designate the stars which follow each other in position. For example, in the familiar constellation of the Great Bear, the first six letters of the alphabet are applied to the consecutive stars which make up the Dipper. The Greek alphabet not being sufficient for all the stars, letters of the Roman alphabet are used when the Greek one is exhausted. Flamstead, Astronomer Royal at Greenwich, two centuries ago adopted the plan of numbering the stars in each constellation. Any such system, however, is imperfect, and, taken altogether, there is a lack of uniformity in the method of designating the stars, except the brighter ones. The following are a few of the brighter and best-known stars which have well-known names.

Individual name	Name on Bayer system
Alcyone	Eta Tauri
Aldebaran	Alpha Tauri
Algol	Beta Persei
Antares	Alpha Scorpii
Arcturus	Alpha Bootis
Bellatrix	Gamma Orionis
Betelguese	Alpha Orionis
Canopus	Alpha Argus (Carinæ)
Capella	Alpha Aurigæ
Castor	Alpha Geminorum
Fomalhaut	Alpha Piscis Australis
Mira Ceti	Omicron Ceti
Mizar	Zeta Ursæ Majoris
Polaris	Alpha Ursæ Minoris
Pollux	Beta Geminorum
Procyon	Alpha Canis Minoris
Regulus	Alpha Leonis
Rigel	Beta Orionis
Sirius	Alpha Canis Majoris
Spica	Alpha Virginis
Vega	Alpha Lyræ

Spectra of the Stars.— When the spectroscope was invented and applied, one of the first uses made of it was to analyze the light coming from various stars in order to see in what respect they differed in their constitution. The result has been to show that, out of several thousand stars which have been examined in detail, it can hardly be said that any two are exactly alike. It is true, in the highest branch of science, that one star differeth from another star, not only in glory, but in the substance which makes it up, as well as in various other features. At the present time the spectra of the stars are best studied by means of photography. The general fact that lights can be photographed which are too faint to be visible to the eye is here applied with great success. When only eye methods were used, it was hardly possible to accurately define or measure the spectral lines given by any but the brightest stars, and even here the measures were so uncertain that few definite results were reached. But, by applying photography, the negative on which the spectrum is impressed can be placed under a measuring engine, and the settings made by means of a microscope with the highest degree of precision that admits of being reached.

At an early period of spectroscopic discovery, Secchi, the Roman astronomer, made an exact classification of the spectra of stars, which he connected with their respective colors. The bluish stars he designated as of the *first type;* those which were almost pure white or slightly yellowish were of the *second type*, while those approaching toward red were mostly of the *third type.* Speaking in a rough way, it would seem that these gradations correspond to the absorption of the light by atmospheres surrounding all the stars. The more dense and the deeper this atmosphere the more blue light it absorbs, and the more red the remaining light appears. It seems, therefore, to be a general rule that the redder stars have the densest and most absorbing atmosphere. From many such stars a large part of the blue and green light is cut off. This deficiency in the blue light may also be due, in some cases, to the stars which show it being not so hot as the others; because we know that the hotter an object the more blue light it radiates in proportion to its red light. But everything we know of the stars leads us to believe that these cases are exceptional.

A very remarkable fact in connection with this classification is that the blue or first type largely predominates in the stars of the Milky Way, while stars distant from the Milky Way mostly belong to the other two types. Quite possibly it may be found that this distinction will enable us to determine in what part of the universe a star is situated, by means of its spectrum. When, at Harvard Observatory, the spectra of the stars were photographed on a large scale, and the number studied brought up into the thousands, it was found that Secchi's classification was quite insufficient. We now have a great number of such classes designated by letters of the alphabet and numerals which are too technical to be set forth in the present article. We shall mention but a single type known as Orion stars, because many of the stars showing it belong to the constellation Orion. A remarkable peculiarity of this type is the great number of fine lines in the spectra, many of which do not belong to any known substance. What gives great interest to it is that the stars which show it belong mostly or entirely to the Milky Way, and have markedly slower proper motions than the stars in general.

One result of spectral analysis is that most of the stars are composed in the main of the same chemical elements which we know to exist upon the earth: iron, calcium and hydrogen seem to be present throughout the whole universe of stars. It cannot yet be said with certainty to what extent elements unknown on the earth exist in the stars, for the reason that the spectrum of an element depends so much upon the conditions of pressure or temperature to which the substance is exposed. We may regard it as certain that, whether elements unknown to us do or do not exist in the stars, the substances which form the stars, and especially the nebulæ, exist in many cases, in a form different from any we have yet produced in the laboratory.

Proper Motions of the Stars.— One of the most remarkable features of the universe is that every so-called fixed star is moving forward on an undeviating path which, so far as we can yet determine, is a straight line. This is called the *proper motion* of the star. Nothing is better calculated to give us an idea of the extent of the universe than the contrast between the speeds of these motions as we know that they really are and the apparent speeds as we observe them from the earth. The actual speed is enormous when compared with any that we can produce by artificial means. The speed of a shot from the most powerful gun that can be made can scarcely, if at all, exceed half a mile per second. But if the motion of any star is as slow as one mile a second, it is only in very rare and extraordinary cases. The average speed of the stars is about 20 miles a second; and this motion, it must be remembered, is not, so far as yet determined, motion round and round in an orbit, but a straight-ahead motion, never relaxing and never swerving. Almost every star, therefore, travels hundreds of millions of miles every year, century after century. And yet, so slow do the motions appear to us that the naked eye can see no change in the configuration of the constellations during a period of thousands of years. A remarkable instance of this kind is afforded by Arcturus, which is, so far as we know, one of the swiftest moving stars in the heavens. It seems quite certain that its speed exceeds a hundred miles a second, and it may be much greater than this. And yet, if Job could again come to life and study the constellation Bootis, in which Arcturus is situated, he would scarcely notice any change in its appearance. There is not a star in the constellation Orion moving so fast that any change would be noticed by the naked eye in 100,000 years. The result is that the motions in question have been detected only by the most refined observations of modern times, extended through long periods. Every star in the heavens appears in the same position when observed night after night. There are very few in which the astronomer can detect any motion by one year of observations. Accurate determinations of position commenced with the observations of Bradley, Astronomer Royal of England, in the middle of the 18th century, who determined the position of more than 3,000 of the brighter stars. Since his time the position of several hundred thousand stars have been accurately fixed. Yet, so small is the apparent proper motion in most cases that it has actually been detected in the case of only a few thousand stars. Even now there are scarcely a hundred stars of which the motions are known to exceed one second in a year. To understand what this means we must reflect that it would take a good eye to see that two stars in the sky, 200 seconds apart, were not a single object.

The following is a list of the stars whose proper motions exceed four seconds in a century. In the first column is given the name by which the star is commonly known; in the second and third its position; in the fourth its magnitude, and in the last its proper motion in a year:

STAR	Position			Mag.	Prop. motion
	R.	A.	Dec.		
	h.	m.	Deg.		Sec.
Cord. 32,416	0	0	—37.8	8.5	6.07
O Eridani	4	11	—7.8	4.5	4.05
Cord. Z. V. 243	5	8	—45.0	8.5	8.70
Ll. 21,185	10	58	+36.6	7.3	4.76
Ll. 21,258	11	0	+44.0	8.7	4.41
Groomb. 1830	11	47	+38.4	6.4	7.05
Barnard	17	53	+4.5	11.0	10.30
61 Cygni	21	2	+38.2	6.1	5.16
Epsilon Indi	21	56	—57.2	4.8	4.68
Lacaille 9,352	22	59	—36.4	7.1	7.00

It is very remarkable that only three of these stars are visible to the naked eye, and these three are below the fourth magnitude. It will be seen that the annual motion of the most rapidly moving star is less than 12 seconds annually. If this star were to continue its course round the sky without ever stopping, it would take it more than 105,000 years to make the circuit of the heavens.

Proper Motion of the Sun.— Our sun being one of the stars, we may expect that it also has its own proper motion. But this motion cannot be directly observed. The only way in which we can detect it is by the relative motion of the other stars, just as we know that a railway train is carrying us along when we see houses and trees seeming to pass by us. The motion of the sun was detected by observing that, notwithstanding the varied directions in which the stars appear to us to be moving, there is an average tendency to move from a point in the constellation Lyra toward the opposite region of the heavens south of Sirius. These two opposite points are near the Milky Way, though not in it. From this general community of motion we infer that our sun, carrying the earth and all the bodies of the solar system with it, is moving toward the constellation Lyra. The point toward which the motion is directed is called the *solar apex*. It was formerly supposed to be situated in the constellation Hercules, but more recent investigations have placed it farther to the east. Its position is still uncertain by several degrees, and there is some difference of opinion among astronomers as to its exact location. But the best results seem to show its position, as defined by right ascension and declination, to be about the following:

Right Ascension, 18 h. 30 m.
Declination, 35° north.

This point is about 4° south of the bright star Lyra. We may, therefore, say that our solar system is constantly journeying toward that region of the heavens where Lyra is situated.

Star Streaming.— The earlier determinations of the point of the heavens toward which our sun is moving were all based on the assumption that there are no widespread systematic motions among the stars themselves, that is, that when large numbers of them are considered any general backward drift of them all must be the effect solely of our own motion through space. If a considerable number of them are moving, or «streaming,» together, the determination will be rendered inexact by this fact, although it is undoubtedly true that the direction and velocity of our motion as just described are very approximately correct. Several instances of star streaming have recently been discovered. Ludendorff has found that five of the bright stars of Ursa Major, though they appear to us widely separated in the sky, are moving together in parallel paths, and Hertzsprung has shown that the Dog Star, Sirius, though from our position it seems so far removed from the others, is also moving with them. The centre of this cluster is about 100 light years from us: Sirius, only 8.6 light years away, is thus far out of the centre.

An even more interesting example was discovered by Boss, who found that 39 stars, lying principally in the constellation Taurus, and which appear scattered over a considerable area of the sky, do, in fact, form a globular cluster which is drifting through space with a velocity of about 25 miles a second. Some 800,000 years ago, this swarm passed nearest our earth, its centre then being 73 light years away. It is now about twice as far away from us as this and at the expiration of 65,000,000 years its 39 scattered bright stars will be so distant that they will appear to us as a faint, round cluster about two-thirds as large as the full moon.

A discovery of more widespread importance, however, is that of Kapteyn, who finds evidence of two very extensive systematic star drifts, the larger being directed toward the star Xi Orionis, and the other in an opposite direction. The cause of this extensive streaming is not known; it has been suggested that it may arise from a falling in toward the centre of the outer stars of the cloud which surrounds us, and which, therefore, may change its shape periodically through intervals of time so great that all other eras hitherto considered in astronomy shrink to nearly nothing in comparison.

Radial Motion of the Stars.— The most wonderful revelations of the spectroscope relate to the proper motions of the stars and lead to the measurement of the speed with which a star is moving to or from our system. This speed is called its *radial motion*. The possibility of determining it rests on the principle that the wave-length of light coming from a star is less when the star is approaching us and greater when the star is moving away from us. Hence, if, on measuring the refraction of a particular ray emitted by a star, we find it to be greater than its regular value, we know that the star is receding from us, and, in the contrary case, that it is approaching us.

It is very interesting that these measures agree as nearly as we could expect with observations on the position of the stars as to the direction in which our solar system is moving. Moreover, they have enabled Campbell to determine with an approximation to certainty the speed of the motion, which is about 11 miles per second. The whole solar system, and our earth with it, has, therefore, been pursuing a journey through space during the whole of human history, nay for hundreds of thousands, possibly for millions of years. Even with this rapid and continuous motion it will probably take us half a million of years to reach the region in which Vega, the brightest star in the constellation Lyra, is now situated.

The proper motions of the stars naturally suggest the idea that these objects all have their proper orbits and are performing revolutions round some centre as the planets do around the sun. The idea of a universe of which this might be true — of a system in which the years were counted by millions of our years is very captivating. But truth compels us to say that up to the present time astronomical science furnishes no sound basis for the reality of such a system: no resemblance of this sort can be traced Moreover the general trend of science is toward the conclusion that the duration of the universe, though very long, is finite and is not sufficient to enable a star to have made many revolutions round any centre.

Double Stars.—A careful watcher of the heavens will notice that there are several pairs of stars in the heavens— two such objects being so close together as to suggest that they must have some connection. The most striking case of this sort is in the Hyades, a V-shapel figure having the bright red star Aldebaran at one end of the "V." In the middle of one of the lines of the "V" are two stars of the third or fourth magnitude, forming a very beautiful pair. This pair is easily to be seen in some part of the sky on any clear evening in autumn or winter. Another case of the same sort is that of one of the brightest stars in the constellation Capricornus, visible in summer and autumn, which has a much fainter star alongside of it. A third case is in the constellation Lyra, one of whose stars of the fourth magnitude can be seen by the naked eye to be composed of two separate stars. But only a very good eye can distinguish them from a single star.

When the heavens are scanned with a telescope, it is found that a great many stars which seem single to the eye really consist of two such objects in close proximity. Sometimes these are of the same brightness, but more commonly one is much brighter than the other. Very frequently the small companion is so faint and so close to the large one as to be lost in the glare of its light, except when very carefully examined by an experienced observer. Such pairs are called double stars.

The first question suggested by these objects is whether the two stars appear in such close proximity merely because they chance to be on the same straight line from us, or whether they are really in each other's neighborhood. The latter is known to be the case, for two reasons. In the first place these double stars are vastly more numerous than they would be if their proximity were merely accidental. Another conclusive proof is afforded by the fact that in many such cases the two stars are found to be revolving round each other, or the small one round the large one, as the case may be. The name *Binary System* is applied to such pairs. The most important and interesting conclusion drawn from the motions of these systems is that the law of gravitation extends to the stars. It is true that we could scarcely doubt such to be the case, even were no such proof available, but it is nevertheless of interest to have independent evidence of it. The revolution of the two stars round each other is in all respects similar to that of the earth and planets round the sun, or that of the moon round the earth. The time occupied in one revolution may be but a few decades, and in one instance it is but 5.7 years, yet in the vast majority of cases, hundreds or even thousands of years are required. As exact observations have only been made on these bodies since the time of Sir William Herschel, there are less than 100 of which the orbits and periods are accurately determined. Thus although the whole number known amounts to upward of 20,000 the determination of the orbits goes on very slowly.

There are two binary systems of special interest because the companion was first discovered through its attraction upon the larger star. One of these cases is the brightest star in the heavens, Sirius. About 1840 it was discovered by comparing observations made since the time of Bradley (1750) that Sirius did not move forward on the celestial sphere with a uniform and even motion, as the other stars did, but that there was a slight irregularity. A few years later a careful investigation of the observations showed that Sirius was moving in a very small orbit with a period of about 50 years. This made it possible to calculate the orbit of an unseen companion which, moving round the star, would produce the apparent orbital motion. In 1860 Alvan Clark, the son and successor of the celebrated maker of telescopes in Cambridgeport, Mass., on pointing one of the newly made great instruments at Sirius, saw a companion star. He knew nothing about the computations that had been made on this object, but when his observations were compared with them, this companion was found to lie in the right direction to produce the observed inequality. The observations since made show that it is going round in the orbit prescribed for it before its discovery.

The other case is that of Procyon, the brightest star in the constellation Canis Minor. Its motion was found to be affected by an inequality somewhat smaller than that of Sirius; but the companion which produced it evaded the scrutiny of the most careful observers until it was discovered by Schaeberle with the great 36-inch telescope of the Lick Observatory. It also was found to be moving in the orbit computed for it before its discovery.

As the power of the telescope has been increased closer binary systems having shorter periods have been continually brought to light. This raises the question whether there may not be vast numbers of such systems in which the two stars are so close together that no telescope will separate them. This question has been answered in recent times by the aid of the spectroscope. We have already described how the radial motions of stars or the motion in the direction to or from our system is measured by this instrument. The determinations have been going on since 1880. As the number of measures increases, it is found that the radial motion of many of these stars varies in a regular period, thus showing that invisible planets are moving round them. A new feature of the universe is thus brought to our knowledge, which, if we had no other instrument than the telescope, would remain forever hidden. The difference between the measures made with the telescope and the spectroscope consists in this: The telescope can show the change in the position of a star only when it is great enough to be visible at the enormous distance of the star. Commonly this change must be measured by hundreds of millions of miles, nay, thousands of millions, else it would never be seen in the telescope. But the spectroscope shows, at any moment, how fast the star is moving to or from us, though it gives us no information as to its actual distance. It is not, therefore, necessary that the star should have moved through a definite space in order to have its motion detected by the change in its spectrum. Having given the speed of the revolution and the period, it becomes possible to determine the size of the orbit.

Pairs of stars discovered with the spectroscope are called *spectroscopic binary systems.* The comparisons in such systems are not, however, necessarily dark stars; the revolutions of a pair of stars, both of which are bright, may be determined with the spectroscope as if one of the bodies were dark. In this case the lines of the spectrum are sometimes double and sometimes single. They seem double when one star is moving from us and the other toward us, and single when the stars are moving laterally to the line of sight from us to them. Thus bright double stars are shown by the use of the spectroscope which no telescope, however powerful, can distinguish to be more than a single star.

That this doubling of the lines is a true indication of a double star system is shown by the fact that at least one spectroscopic pair can also be seen as a double in the telescope. The orbits derived from the visual measures and from a study of the light, respectively, are in remarkably close agreement.

The most successful discoveries in this line have been made in recent times by or under the direction of Professor Campbell, in the Lick Observatory, where it may almost be said that a new branch of astronomy has been created. The discoveries of these objects are now going on so rapidly that it is impossible to set any limit to their number. The general rule is found to be that the orbits described do not differ greatly in magnitude from those described by our planets in moving round the sun. That is to say, there are few or no orbits yet known which are as large as that of Neptune. There is, however, no limit to the minuteness of the orbits, some stars revolving almost in contact with each other.

Besides double stars, there are triple and quadruple stars of such variety that it is impossible to give any general description of them. The most remarkable quadruple system is found in the great nebula of Orion, where Theta Orionis, which looks to the naked eye like a single star, is shown by the telescope to consist of four stars forming a trapezium; this is, therefore, known as the trapezium of Orion. Altogether, these systems show the infinite variety of the great bodies which make up the universe. The pairs of stars which form a binary system may be of every degree of brightness and of very different masses. Their times of revolution range from two or three days to unknown thousands of years. In a few cases the masses have actually been determined. It is a curious fact that they do not vary so much as does the brightness of the stars. When a bright and a faint star form a binary system, the mass of the faint star is generally out of proportion to the amount of light it emits. We have already remarked that many stars are thousands of times as bright as the sun; but it is a curious fact that none have been found to have even hundreds of times the mass of the sun.

Variable Stars.— To ordinary observations, even to observations extending through generations, the light of the stars seem to be as permanent as the order of nature itself. But, although this is true of the great majority of stars which stud the heavens, it is now found that there are exceptions to the rule. So numerous have these exceptions become that the study of variable stars has developed into one of the important branches of astronomy. The first star which was found to be variable in its light is known as Mira Ceti, or the wonder of the constellation Cetus, the Whale. This constellation extends from two hours to three hours of right ascension, and its central regions are situated a little south of the equator. It is on the meridian at some hour in the evenings of the winter months. The star Mira is quite invisible to the naked eye the greater part of the time, but is found to blaze up at regular but slightly varying intervals of about 11 months, sometimes attaining to the second magnitude. After remaining visible to the naked eye for a few days, it gradually fades away into invisibility, but may always be seen in a telescope. Its greatest brightness varies markedly. Sometimes it brightens up only to the fifth magnitude, and is then not at all conspicuous.

There are two other remarkable variable stars. One is Algol in the constellation Perseus, which may be seen in some part of the northern sky at some hour on almost any night of the year except in April and May. Commonly this star is between the second and third magnitude, and is usually classified as of the second magnitude. At regular intervals of a little less than three days, it fades away to the fourth magnitude, and then, after a few hours, gradually increases again to its regular brightness. It is now known that this diminution of light is a partial eclipse of the star; the brighter star is about 51 times as bright as our own sun, while the so-called «dark» companion is about three and one-third times as bright. Thus the companion is very far from being a dark body, but its interposition so greatly reduces the light which we receive from the brighter star that the effect of an eclipse is produced.

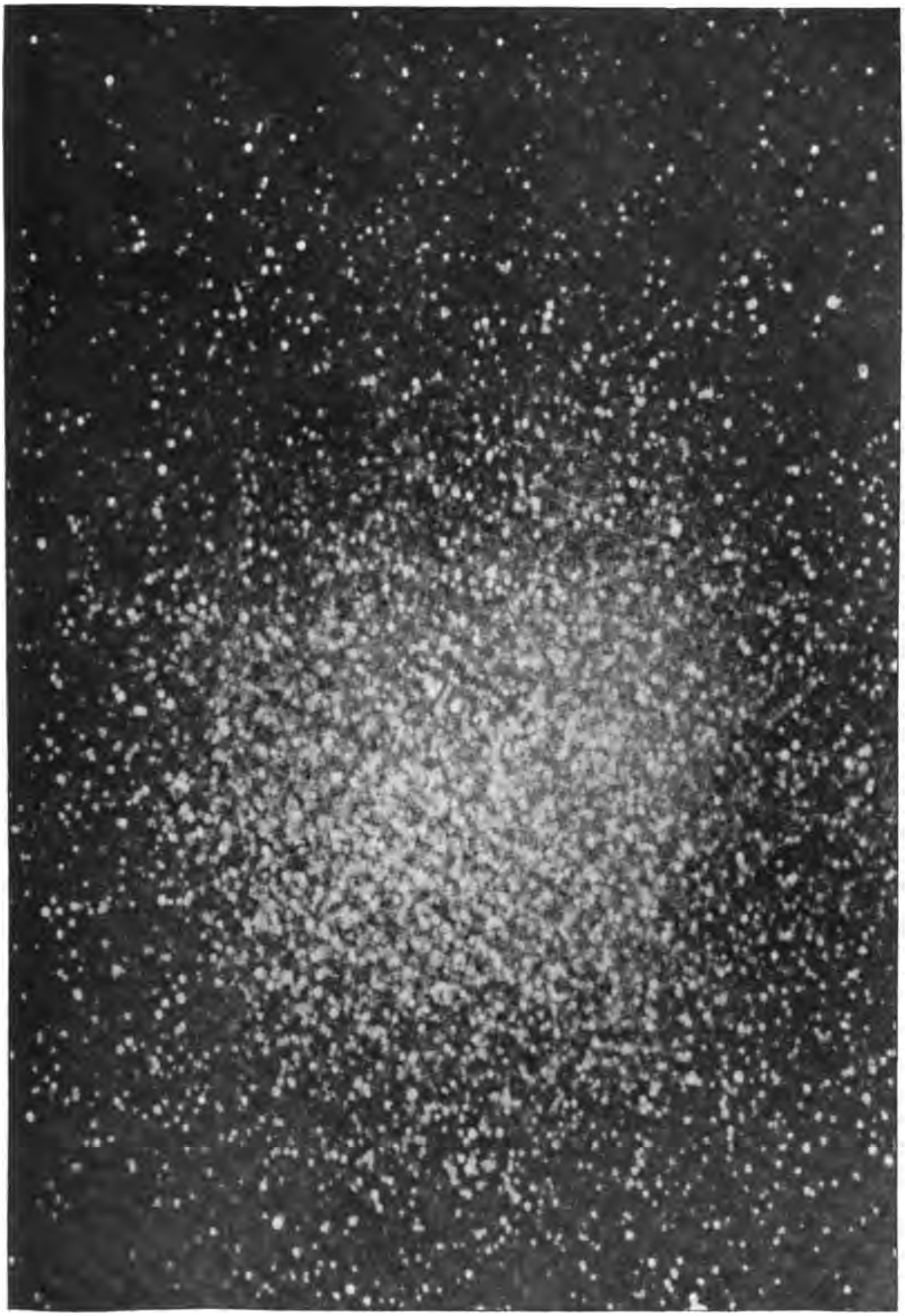
In another class of variable stars these two bodies are each of noticeable brightness so that the light which we receive from them varies twice in each revolution, once when the brighter star partially hides the fainter one, and once when it is itself partly hidden. Strictly speaking, the system of Algol should be now included in this class since by the employment of the delicate selenium photometer the light of its companion can be definitely measured.

The most remarkable of this class is Beta Lyræ, quite near the bright star Vega. It may be seen in some part of the northern sky during the spring, summer and autumn. Although the changes in its light are not striking, one who looks at it carefully night after night will notice them.

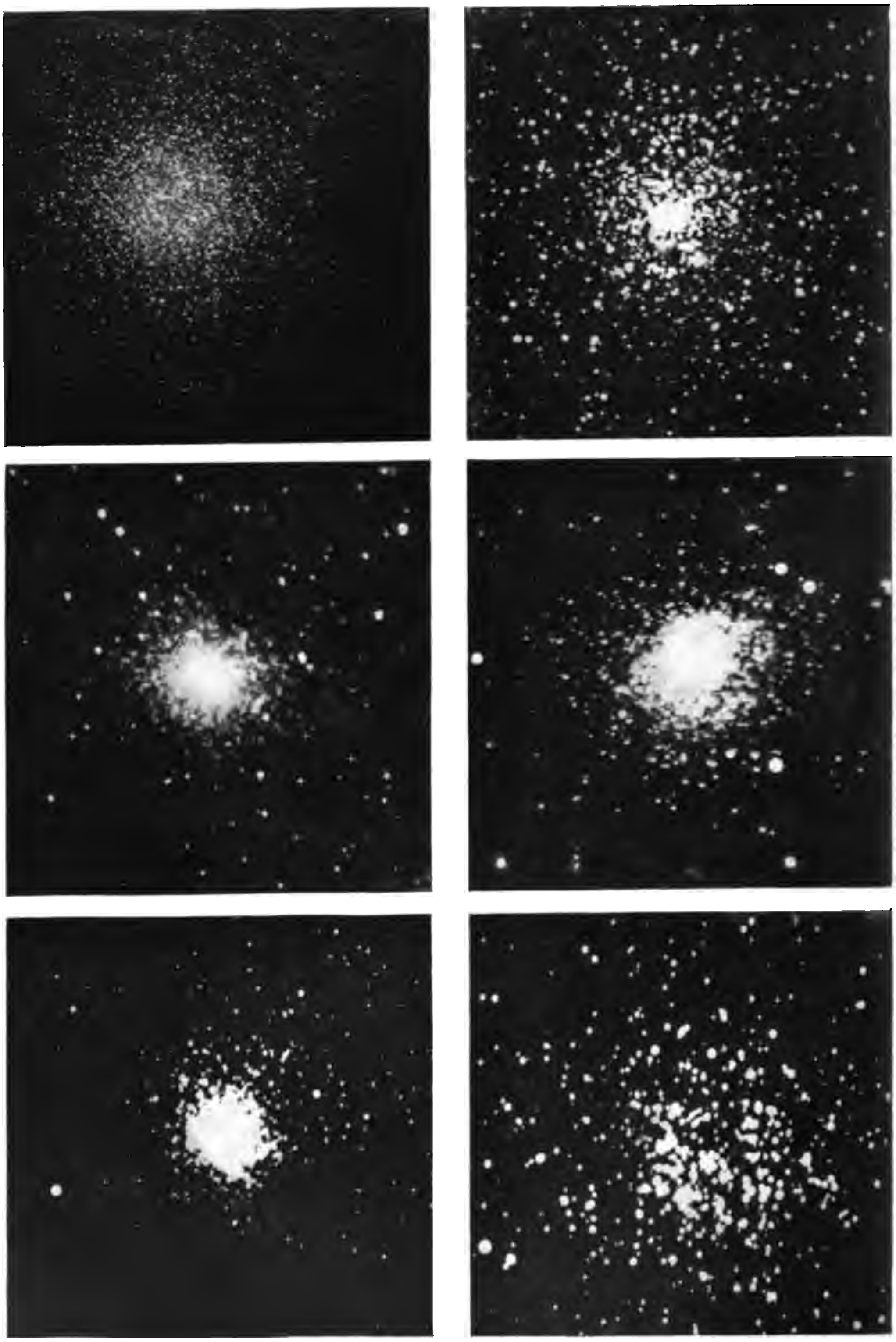
These three stars are only examples of a number of such objects now known to exceed 1,000, scattered over the whole sky. As observations become more and more accurate, it is found that quite a number of the stars visible to the naked eye are subject to slight fluctuations of light, mostly in a more or less regular period, but sometimes in a quite irregular way. Spectroscopic observations render it somewhat probable that in most cases the regular changes are produced by bright or dark bodies revolving round the star in very eccentric orbits. Sometimes they partially eclipse the star, as we have already mentioned; but in many other cases it seems likely that they make the star blaze up by the disturbance they make when they approach close to it in their orbits.

The general rule is that a variable star goes through its series of changes in a regular period. At a certain day and hour it reaches its least brightness, which is called a *minimum*. Then it begins to increase in light. In the course of a certain number of hours or days it increases to its greatest brightness; then it begins to decrease and once more fades away to its minimum. The length of time between two minima is a *period*. Commonly the successive periods of a variable star are nearly equal to each other, so that the stage of brightness at any future time can be predicted with confidence. The periods range very widely from a few hours to about 600 days. It is very remarkable that no period yet known exceeds two years. There are many periods less than a month; but there are only eight between 50 and 100 days. The number then increases up to 350 days. The greatest number of periods is just about one of our years, a coincidence which of course is a pure accident. Above this their frequency rapidly falls off. This limitation of the period strengthens the view that the variability of a great number of stars is produced by the disturbing action of an immense body revolving round the star in a very eccentric orbit.

New Stars.— In past generations, when the whole universe was supposed to be only a few thousand years old, it was quite natural to expect that new stars would from time to time be created to shine among their fellows. But this view has now to be modified. It is true that, from time to time, a star is seen to blaze out where none was known before. But the theory of a new creation is refuted by the fact that such stars invariably fade out in the course of a few weeks or months. On some very rare occasions they have continued visible to the naked eye for a year or more, and they can commonly be seen by the telescope for several years. The first remarkable case of this sort of which we have a scientific record occurred in 1752. On 11 November of that year, Tycho Brahe, the celebrated astronomer of Uraniburg, observed a star of the first magnitude in the constellation Cassiopeia. Before the end of the month it was so bright as to be visible in full daylight. Then it began to fade away and finally disappeared from view in May following. This was before the invention of the telescope, so that Tycho was unable to trace the star any longer. Thirty-two years later Kepler observed a similar star in the constellation Ophiuchus. This star continued visible to the naked eye for more than a year, but it never became so bright as the star of Tycho. As the heavens were more carefully watched, and photographs of the stars were taken, these new stars were found to be more frequent than was formerly supposed. During the 19th century 11 were observed to blaze out, more than half of which were during the last 14 years of the century. But the greatest number of them scarcely reached the limit of visibility to the naked eye, being discovered principally by photography. On 20 Feb. 1901 the most wonderful of these objects which had been seen for 300 years blazed out in the constellation Perseus. In two or three days it was the third brightest star in the heavens. Then, following the example of its predecessor, it gradually faded away, though it



PHOTOGRAPH OF THE GREAT STAR CLUSTER OMEGA CENTAURI, TAKEN AT THE D. O. MILLS BRANCH OF LICK OBSERVATORY, SANTIAGO DE CHILE



PHOTOGRAPHS OF STAR CLUSTERS TAKEN AT LICK, YERKES, ROBERTS, AND HARVARD OBSERVATORIES

Omega Centauri (Lick)
M-14, Ophiuchi (Roberts)
M-62, Scorpii (Harvard)

M-15, Pegasi (Yerkes)
M-2, Aquarii (Roberts)
M-11, Antinoi (Harvard)

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still remains visible in the telescope. It is not yet certain whether this object was impressed on any photographs until within a few days of its first appearance.

Similarly on 8 June 1919 a brilliant new star appeared in Aquila, almost on the border between Aquila and Serpeus. When brightest this was almost as bright as Vega, the brightest star of the northern heavens, and it was of a very blue color. It rapidly faded away, until now it is only a telescopic object.

By what convulsion of nature these objects burst forth it is quite beyond the power of our present science to decide. It is certain that the amount of light and heat emitted by these stars was suddenly increased hundreds or even thousands of times. One of the most plausible explanations is that of a collision. It is supposed that the star itself may have collided with another — perhaps a planet in its neighborhood — or rushed to its own destruction in some nebulous mass. But this is only conjecture.

Very curious has been the fate of these objects after they have faded away. Those recently observed have been found to change into nebulæ; a mass of glowing gas emitting the bright spectral rays of hydrogen and other gases. Photographs and spectroscopic observations give evidence of some explosive action, throwing out corpuscles with immense velocity in every direction, but throw no light on the origin of the explosion.

Star Clusters.— One of the remarkable features of the heavens revealed by the telescope consists in star clusters — great numbers of these bodies crowded into a space which, measured by the expanse of the heavens, must be comparatively limited. It is not at all uncommon to find hundreds of stars in a single bunch so closely packed together that, to the naked eye or in a small telescope, nothing is seen but a minute patch of light. One of the most remarkable of these contains 60,000 stars, situated in the constellation Hercules, another in the constellation Centaurus was described by Sir John Herschel as one of the most remarkable objects in the heavens. There exists every variety of such clusters, from these closely packed ones to the agglomerations of the Milky Way, which any careful observer of the heavens can see on any clear evening during the late summer and autumn. Close together as the component stars of these clusters appear to be there is no doubt that they are really separate from each other by distances vaster than those which separate the planets of our solar system; otherwise the most powerful telescope would not distinguish them as separate stars, but present them to our view as if confused together in one mass of light.

By several different methods the distances from us of the globular clusters have very recently been found by Shapley of the Mount Wilson Solar Observatory. It is shown that while the cluster in Centaurus is the nearest, the more distant are not infinitely remote from our Milky Way cluster, but are outside of it and apparently connected with it. They are, in short, now known to be small universes of stars, the distances through them being measured in hundreds of light years instead of in tens of thousands as in the case in our Milky Way cluster.

It is a remarkable fact that many of these clusters contain a great number of variable stars. This fact, taken in connection with the probable cause of variability already mentioned, makes plausible the idea that close binary systems are very numerous in the clusters. If, at any one moment, all the stars of the cluster were at rest, they would in course of time be drawn together by mutual gravitation. Each star must, therefore, be in motion relative to the others, describing some kind of an orbit around their centre of gravity.

The laws of revolution in cases like this must be very complicated, but as they require thousands of years to go through their changes and accurate observations have been made for hardly more than a century, astronomers are not yet able to investigate them fully.

Constitution of the Stars.— There is no reasonable doubt that the general constitution of the stars is the same as that of our sun; and that they consist of masses of intensely hot vapors of the substance composing them, compressed together by the mutual gravitation of their parts. As we have already said, the stars are composed in the main of the substances found to exist in the sun, but, probably, in a great variety of forms as regards density and temperature. The spectra of the stars, consisting, as most of them do, of a bright continuous spectrum crossed by dark lines, show that we see the luminous surface through an atmosphere cooler than itself, though really intensely hot.

The stars differ enormously in their actual luminosity, that is, in the actual amount of light emitted by each. If they were all equally luminous we could form an idea of their relative distance by their brightness; the farther a star was away the fainter it would shine. But as a matter of fact, some of the brightest stars in the heavens are so distant that their parallax proves to be immeasurably small. This is not the case with Sirius, the brightest of all, which has a parallax of 0" .38, showing it to be situated at a distance from which light would travel in about nine years. But the next brightest, Canopus (not visible farther north than our Southern States), is so distant that no parallax can be shown by the most refined measures. The conclusion is that it must be 10,000 times as luminous as our sun; possibly 100,000 times. This is the case with several stars in or near the constellation Orion. At the other extreme, we find that among the nearer stars are several not visible to the naked eye. It is true that the nearest of all, Alpha Centauri, is nearly of the first magnitude; but the next in order, 61 Cygni, is only of the sixth magnitude; two others are quite invisible to the naked eye. This shows that there are stars much less luminous than the sun, and that the greatest stars are probably millions of times more luminous than the smallest ones.

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SIMON NEWCOMB.
Revised by ERIC DOOLITTLE.

STARS AND BARS, The, a name applied to the flag of the Confederate States of America. It was an adaptation of the stars and stripes. On 5 March 1861 the Flag Committee appointed in the provisional Senate of the Southern States recommended that «the flag of the Confederate States shall consist of a red field with a white space extending horizontally through the centre, and equal in width to one-third the width of the flag.» It was first displayed 4 March 1861, simultaneously with the inauguration of Lincoln, being unfurled over the State House at Montgomery, Ala. In 1863 the Confederate Senate adopted a white flag with one blue star in the centre, the Stars and Bars bearing too close a resemblance to the Stars and Stripes.

STARS AND STRIPES, The. See FLAG OF THE UNITED STATES.

STARVATION, or INANITION, lowered vitality, accompanied by emaciation, enfeeblement which if prolonged results in death, through lack of food. Starve is derived from Old English *steorfan,* to die. The phenomena of starvation presents subjects of great interest from their bearing upon phenomena induced through the inability to take nourishment occasioned by some diseases. According to Chossat, the symptoms which intervene in starvation are at first marked by a very rapid diminution in the weight of the body; this decrease, however, becoming more gradual as death approaches. A striking uniformity is found between the period at which death results from starvation and the loss of weight experienced. Thus Chossat found that in different warm-blooded animals death resulted when the body had lost about 40 per cent or two-fifths of its original and normal weight. Great variations undoubtedly existed in the extremes of Chossat's cases; the circumstances which seem most powerfully to have affected these results being the amount of fat contained in the body prior to the beginning of the starvation period. The animals which had most fat stored up lost weight quickest and at the same time lived longest. Chossat found that in animals undergoing starvation the symptoms observed during the first half or two-thirds of the period are those of calmness and quietness; the temperature then becoming elevated, restlessness and agitation prevails; and when life is terminated by the rapid fall of the temperature stupor supervenes. The extremities become cold and weak, and are finally unable to support the weight of the body; while the pupils of the eyes become dilated; and occasionally at death convulsive twitchings may be present. The excreta are small in quantity after those which are voided as the result of the food last partaken of, and consist chiefly of greenish matters, probably derived from the biliary secretions. At death the fæces become watery and contain saline matters.

The fatty matters are almost entirely removed by starvation, and the blood loses three fourths of its original amount. It is probable that the total nutritive powers of the body during starvation go to nourish the nervous tissues, the loss of which is very small; while the true mode of death from starvation appears to be death from want of heat, the body being preserved alive, notwithstanding the want of fresh nutritive material, by the combustion or absorption of the fatty matters it contains. Chossat also found that proportionally to the more active nutrition and waste in young animals, such died sooner from starvation than older forms; and he also determined the equally important fact that if young animals especially are supplied with an insufficient amount of food, they succumb as if they were actually starved; the process of starvation being of necessity more gradual in the latter instance. The mere variations in the temperature observed by Chossat formed more prominent points of note in his observations than the actual decrease of heat. It fluctuated or varied daily, in some cases, some 5° and 6° F., instead of 1° and 2° F., as observed in the normal and healthy state of the body. In the human subject the symptoms of starvation have been closely studied by physiologists, with the effect of determining a stated order in their appearance and effects. The preliminary hunger appears to be accompanied in the first instance by severe pain in the stomach and epigastric region generally. The thirst becomes intense and although undoubtedly in man the want of water induces death at a much earlier period than where drink is attainable by lower forms (for example, birds), the want of water may in reality make comparatively little difference in the invasion of the fatal period. Sleeplessness appears to be early manifested; the severe pain at first felt in the stomach gradually ceasing. A characteristic feeling of sinking and weakness is described as occurring in the epigastric region, the thirst still continuing to an agonizing degree. The face assumes meanwhile an anxious, pale expression; the eyes are wild and staring; and the whole countenance and body participate in rapid general emaciation. The body latterly exhales a fetid odor; the breath and lung secretions become strong-smelling; and the skin is said to become covered with a brown secretion — these results, doubtless, arising from the decomposition and organic decay of the tissues. The gait totters, the mind becomes impaired, delirium or convulsions may ensue and death occurs, with or without the accompaniment of diarrhœa. Postmortem reveals a state of anæmia in all parts of the body but the brain, which appears to the last to receive a due supply of blood. The fat is entirely wanting and the various organs and tissues have greatly lost in bulk. The coats of the small intestine are found exceedingly thin. The gall-bladder generally contains much bile, and the body goes more rapidly to decay than after death from ordinary causes.

Starvation suggests inquiries respecting abstinence in diet and from various or particular kinds of food. A sudden and unfavorable change in a given dietary may induce, in virtue of the new food containing a low percentage of certain nutritive matters, symptoms analogous to those of starvation. Want of nutriment produces an incapacity for the digestion of whatever amount is supplied, a result probably due to nervous causes and primarily perhaps to the want of stimulation of the appetite through insufficient secretion of gastric juice.

Where the temperature of the body is maintained in tolerable efficiency, life may be prolonged for great periods without food, a state of syncope prevailing — as in several noted cases of so-called apparent death. It was found by Chossat that in the case of animals whose death seemed imminent from starvation, restoration took place primarily by the application of artificial heat. They thus manifested activity, and were able afterward to partake of food. From 8 to 10 days is regarded as the usual period during which human life can be supported without food or drink. If water be given this period may be greatly exceeded, and where a moist condition of the atmosphere exists life may for the same reason be prolonged. A case is recorded in which some workmen were dug out alive after 14 days' confinement in a cold damp vault; and another is mentioned in which a miner was extricated alive after being shut up in a mine for 23 days, during the first 10 of which he subsisted on a little dirty water. He died, however, three days after his release. Life has been prolonged for 60 days in a person suffering from religious mania who abstained from food, supporting his existence by sucking an orange. In some remarkable cases of nervous hysteria and other diseased conditions no food may be taken and yet the body be perfectly sustained. The system is disposed or becomes inured to the abstinence, just as under other conditions it exhibits a want of susceptibility to the ordinary effects of certain medicines. (See FASTING). Consult Benedict, F. G., 'A Study of Prolonged Fasting' (Washington 1915); Davies, 'Starvation' (in *Popular Science Monthly* 1884-85, Vol. XXVI); Leeson, 'Death from Starvation' (in *Dublin Medical Press* 1847).

STARVED ROCK, a high, isolated pinnacle on the south side of the valley of Illinois between Utica and Ottawa, La Salle County, Ill. Its name indicates the fate of the last of the Illini Indians who were besieged by invading Iroquois Indians until their supplies gave out. This rock, known as La Rocher to the French, was a famous locality all through the early history of the north-central Illinois region for it is a conspicuous landmark at the head of navigation in Illinois River. Late in 1682 La Salle built on its summit the fort «Saint Louis des Illinois» which was a most important outpost and intended to be the centre of a large French colony. With sheer walls rising 130 feet above the river at its northern base and almost inaccessible from the bluffs on its south side, it was easy to defend. The area on top was somewhat less than an acre. The fort was abandoned about 1690 and the Indians and traders finally left its vicinity. The rock consists of soft, massive, nearly horizontal sandstone of Saint Peters formation which constitutes the bluffy sides of Illinois Valley in La Salle County. It was isolated by erosion from the main body of the formation in the neighboring bluffs. It is claimed that the first bituminous coal used in the United States was obtained near Starved Rock about 1695. On account of its great historic interest and highly picturesque surroundings, Starved Rock has been made a State park of 10,000 acres. Consult Baldwin, C., 'History of La Salle County'; Carter, J. D., 'Last of the Illinois,' and Sauer, C. O., 'Geography of the Upper Illinois Valley' (State Geological Survey, Bulletin 27).

STASSFURTITE, a massive variety of the mineral boracite (q.v.) occurring chiefly at Stassfurt, Germany, where a few hundred tons are annually produced.

STATE. Political scientists of the present day distinguish sharply between the idea connoted by the term «state» and that indicated by the word «government.» By «state» is meant the body-politic abstractly considered,— the entity that possesses and exercises the sovereign political will. By «government» is meant the mechanism of political rule, the ensemble of the agencies through which the tasks of the state are performed. The present article will be devoted to a discussion of the nature of the state. A treatment of GOVERNMENT will be found under that title.

As distinguished from a society, by which is meant simply an aggregate of human beings living together and united by mutual economic and social interests, a state is a body of individuals that has assumed an organized form, that has a definite membership, and has created for itself specific organs for expressing and enforcing its corporate will. Thus, in order that there may be a state, three elements must be present: (1) An aggregate of human beings, individually termed citizens or subjects, forming a single group and as such termed a «people»; (2) a political apparatus, termed a government, and administered by a corps of officials collectively termed a magistracy; and (3) a body of rules or maxims, written or unwritten, which are generally recognized to be such as may rightfully be enforced by those entrusted with the exercise of the powers of the state. Whether or not to these three essential elements there should be added a fourth, namely, a definite area of land, there is a difference of opinion. The eminent German publicist Bluntschli, who may be taken as a representative of one view, defines a state as "the politically organized national person of a definite country." On the other hand, Holland declares that "a state is a numerous assemblage of human beings *generally* occupying a certain territory, among whom the will of the majority, or of an ascertainable class of persons, is, by the strength of such a majority or class, made to prevail against any number who oppose it." The definition of Bluntschli is undoubtedly applicable to all modern civilized states, but certainly is not descriptive of very many bodies-politic of the past. Indeed, political sovereignty, by which is meant the supreme power of the state, was for many years, according to the ideas of the peoples of western Europe, not territorial at all, but based upon a personal allegiance of the subjects to their rulers.

A people, a government and a body of laws are what may be termed the essential material elements of which a state is composed. In addition to these there is one characteristic that it must possess in order properly to deserve its title and to be distinguished from the others and lower types of political life. This unique and distinguishing characteristic is sovereignty. By sovereignty is meant the highest, or supreme power. It thus means that its possessor is itself the ultimate source of all the laws that are enforced over the territory which it claims as its own, and over citizens or other persons subject to its authority. It means, in short, formal legal omnipotence. The word formal is used, for of course the power of control that any state may actually exercise is limited by the intolerance of its subjects of oppression. But, formally, a state, because legally subject to the control of no other law-making power, has the power to issue such legally binding commands as it sees fit. Directly or indirectly, it is the source of all the rules that regulate not only the conduct of its subjects and others for the time being subject to its authority, but those that determine the form of its own government and the respective powers of its several organs and officials. The exercise of all political powers, either by individuals or associations of individuals, are, therefore, validated only by its sanction. The state is thus legally supreme, not only as the ultimate source of all law, but is itself the determinator of the matters that it will regulate, and the manner in which it will regulate them. Thus, as the Austrian publicist, Jellinek, has put it: "Obligation through its own will is the legal characteristic of the state."

It is the state, it is to be observed, that is the possessor of sovereignty — its "subject," as continental writers express it — not the government. To the government is entrusted only the execution of the sovereign will of the state. The powers of each governmental organ and of each public official are obtained from the state and are limited and defined by its laws. Thus at any given time a citizen, though potentially subject in every matter of life, liberty and property to the will of his state, possesses a sphere of freedom, defined by existing laws, upon which those exercising political authority may not trespass. To quote the words of Professor Burgess: "The individual is defended in this sphere against the government by the power (the state) that makes and maintains and can destroy the government; and by that same power through the government, against encroachments from any other quarter. Against that power itself, however, he has no defense."

Sovereignty is an attribute of a political body that has to be demonstrated as a matter of fact, and not as a matter of law. In other words, there is no proper distinction between *de facto* and *de jure* states, these terms being applicable only to governments. (See GOVERNMENT). If a given community of human beings, yielding a general obedience to an established government, asserts and fairly demonstrates that it is able to maintain a freedom from the control of any other political power, it becomes by that very fact a state, and is entitled to recognition by other states as such. It is, however, the actual fact of independence from foreign control and maintenance of domestic order that demonstrates the existence of the sovereignty of the state in question, and not its recognition as a state by the other powers. Thus, for example, the American colonies ceased to be dependencies and became states not by reason of their recognition as such by England and European nations, but because of their actual ability to maintain that freedom from Great Britain's control which they formally asserted in 1776. The sovereignty of a state thus bears a double aspect. Considered internally, that is, from the viewpoint of municipal law, it appears as legal omnipotence. Looked at from the viewpoint of its relations to other states it appears simply as independence. In the one case, it means the affirmative legal power of enforcing its will upon all those subject to its authority. In the other case, it signifies simply freedom from foreign control. From the domestic standpoint, it signifies supremacy. From the international standpoint, it means equality.

The state, though itself the source of all law, can only operate through law. That is to say, an expression of its sovereign will can validly proceed only from those legislative mouthpieces that, by already existing law, have been granted the right to voice its commands, and these commands may be legally enforced only according to laws already established. Because of its legal omnipotence the state may at any time alter these rules according to the methods provided for the amendment or repeal of laws, but as they exist at any time the laws control. Any action not sanctioned by their provisions, however much approved by those in political authority, cannot, strictly speaking, be termed an action of the state.

Itself the creator of all law, the state is not itself a product of law. Constitutions create governments, not states. They are the creations of states already existent. The creative force, in the birth of states, is that feeling of unity interests and desires that leads a society of human beings to assume a corporate form and create the political organs necessary for the attainment of all those interests that are connected with or arise out of their existence as a national unit. This being so, it follows that sovereignty cannot arise out of any formal, legal or conventional act. In other words, a state cannot be created by formal agreement between individuals, as postulated by the social compact theory, nor brought into being by a compact between sovereign states. By a surrender of private rights, individuals cannot create a public right; by a treaty agreement, there cannot be created a political power with a legal authority superior to that of the parties establishing it. From this last fact it irresistibly follows that any so-called composite or federal state that has for its basis a treaty or compact between states is not in truth a state at all, but a mere league of states, and this, notwithstanding the fact that very extensive powers may have been granted to the central governing power. Envisaged as a legal person, the sovereignty of a state represents the supremacy of its will. As thus representing a supreme will, sovereignty is necessarily an indivisible unity. A divided or double sovereignty is an impossibility. A given body-politic therefore either possesses sovereignty and is for that reason a state, or it has not sovereignty, and, as a result, is not a state but simply an administrative division of the state that possesses sovereignty over it. In all strictness then, it is a misuse of words to speak of a federal state, if by that term is meant a state formed by a federation of states; for if, in such a federation, sovereignty is held to rest in the central body, that body is a state, and its constituent commonwealth members are *ipso facto* reduced to a non-sovereign condition, and therefore to the status of administrative districts. If, however, the federating units each retain their sovereignty, they remain states, and no central sovereignty or state can be held to be created. In the one case, there exists but one state with a government composed of one set of central or federal organs and as many sets of local governmental organs as there are members of the union. In the other case, there exist as many states as there are confederated units, an equal number of state governments, and a central government that acts as the common agent of the several states; but no central state.

The line of distinction between a single national state composed of non-sovereign bodies-politic enjoying extended powers of self-government, and a confederation of states with a central government exercising many of the most important sovereign powers, is not always easy to draw. The distinguishing criterion is not the amount of powers actually vested in the central government as compared with those retained by the individual commonwealths, nor whether the operation of federal law is upon the individual states themselves or directly upon their citizens, nor, necessarily, upon the manner in which the articles of union may be amended. The one absolute test is as to the power or lack of power of the members of the union themselves to determine, in the last resort, not only the extent of the obligations imposed upon them by the articles of union, but their constitutional right to withdraw from the union when they see fit.

Bearing in mind the distinction between the possession of the sovereignty itself and the mere exercise of certain of its powers, it is seen that a state may, without in any wise impairing its sovereignty, delegate the execution of its commands not only to governmental agencies of its own creation, but to those of other states; for, so long as such other states, or their governments, act but as the agents of the first state, it is the sovereign will of that state that is executed. And, furthermore, whatever may be its actual power, the state in question has the legal right itself to assume again the actual exercise of the powers it has granted. Such a withdrawal of delegated powers may be in violation of existing treaties, and, therefore, constitute a just ground for complaint, but it is not an illegal act, for treaties do not create law in the strict positive sense. Instances of the delegation by states to other states of the exercise of important powers is seen in the many so-called protectorates that exist at the present day. Confederacies, real and personal unions, and colonies are not similar examples, for in them the exercise of powers is granted to government organs created by the sovereign parties themselves.

Theoretically, there is no limit to the extent to which a state may go in the delegation to other states of the exercise of its power. If, however, in any one respect it is absolutely deprived of a power, so that it cannot legally, at its own discretion, resume the exercise of it, its legal omnipotence is destroyed and, together with it, its sovereignty and right to the title state.

Because the denial of the name state to non-sovereign powers makes it necessary to refuse that title to the many bodies-politic that generally have been, and are, so designated, as for example, the members of a federation such as the United States of America, many writers have endeavored to discover some distinctive attribute other than sovereignty that will serve sharply to distinguish states from provinces, departments and other simple administrative districts. The better opinion would seem to be, however, that these efforts have failed, and must continue to fail. With the test of sovereignty discarded, the dividing line between states and other political bodies becomes an indeterminate one, and, therefore, an exact definition of a state an impossibility. Logical exactness, therefore, even at the expense of wounding political sentiments, requires an adherence to the definition of a state as a necessarily sovereign body.

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STATE APPOINTMENTS. See APPOINTMENTS, FEDERAL, STATE AND LOCAL.

STATE APPROPRIATIONS. See APPROPRIATIONS, AMERICAN SYSTEM OF; BUDGETS, AMERICAN.

STATE BANKING SYSTEMS. See BANKS AND BANKING — STATE BANKING SYSTEM (Article 10).

STATE BANKS. See BANKS AND BANKING — STATE BANKING SYSTEM (Article 10) and BANK ORGANIZATION AND MANAGEMENT (Article 15).

STATE BOARD OF EQUALIZATION. See TAXATION.

STATE BOUNDARIES. See BOUNDARIES OF THE UNITED STATES.

STATE BUDGETS. See BUDGETS, AMERICAN; APPROPRIATIONS, AMERICAN SYSTEM OF.

STATE BUILDING LAWS. See BUILDING LAWS.

STATE COLLEGE OF WASHINGTON, The, located at Pullman, Wash. It was founded in 1890 in pursuance of the national land grant act of 1862 endowing agricultural and mechanical colleges. The national government granted 190,000 acres of land, the proceeds of the sale of which will constitute a permanent endowment for the institution. Women are admitted on equal terms with men. The regular courses are offered by the following colleges and schools: (1) College of Agriculture, which is composed of the following departments: Animal Husbandry, Agricultural Engineering, Dairy Husbandry, Farm Crops, Farm Management, Forestry, Horticulture, Plant Pathology, Poultry Husbandry, Soils. (2) School of Education. (3) College of Home Economics. (4) College of Mechanic Arts and Engineering, which is composed of the following departments: Architecture, Mathematics and Civil Engineering, Mechanical and Electrical Engineering, and Physics. (5) School of Mines. (6) School of Music and Applied Design. (7) School of Pharmacy. (8) College of Sciences and Arts, which is composed of the following departments: Botany, Chemistry, Chemical Engineering, Economic Science and History, English, Foreign Languages, Geology, Zoology. (9) College of Veterinary Science. (10) Department of Military Science and Tactics. (11) Department of Physical Education and Athletics.

In all the above departments the work in the four-year courses leads to the degrees of bachelor of arts or bachelor of sciences. The School of Pharmacy offers a two-year course leading to the degree of graduate in pharmacy (Ph.G.), and also a three-year course leading to the degree of pharmaceutical chemist (Ph.C.), in addition to the four-year course which leads to the degree of bachelor of science in pharmacy. The College of Veterinary Science also confers the degree of doctor of veterinary medicine (D.V.M.).

The degree of master of arts (M.A.) or master of science (M.S.) is conferred upon the completion of one full year of work after receiving the bachelor's degree from this institution or another institution of well-recognized standing. Professional degrees in Engineering are conferred upon graduates of the State College who have been in successful professional work for at least three years and have had charge of difficult engineering or industrial enterprises.

There is also a Department of Elementary Science to which students are eligible after the completion of the eighth grade of the public schools. The courses offered in this department are largely along vocational lines in agriculture, commercial and mechanic arts.

The study of military science is required of all male students.

The college grounds include approximately 650 acres, 75 of which is set apart for the college campus. The buildings include the Administration Building, Bryan Hall, named in honor of Ex-President E. A. Bryan, Science Hall, Morrill Hall, Van Doren Hall, College Hall, Mechanic Arts Building, Mechanical Building, Veterinary buildings, James Wilson Hall, Music Conservatory, Ferry Hall, the dormitory for men, named for the first State governor of Washington, Stevens Hall, the dormitory for women, named for the first territorial governor, gymnasium and armory, College Hospital and the president's house.

The laboratories for instruction in the biological and physical sciences are well equipped with modern appliances. The library in 1917 contained more than 60,000 bound volumes and more than 100,000 unbound pamphlets and books. The students in 1917 numbered 2,130 and the faculty 225.

In addition to the colleges and schools mentioned above, in which courses leading to degrees are offered, the institution operates an agricultural experiment station in which the following departments are maintained: Agriculture, Botany, Chemistry, Dry Land Investigations, Entomology and Zoology, Horticulture, Irrigation Engineering, Veterinary Science and Plant Pathology. The experiment station is partly supported by funds established by acts of Congress. There is also a department of extension service operated in co-operation with the United States Department of Agriculture which is partly supported by the Smith-Lever fund established by Congress in May, 1914. The extension service consists largely in extension work in agriculture and home economics.

STATE CONSTITUTIONS. See CONVENTIONS, CONSTITUTIONAL IN THE UNITED STATES.

STATE CONTROL, Growth of. I. The State, an organized political entity, possessing and exercising sovereign powers, has always since its establishment controlled more or less completely the activities of its members, social, political, economic and moral, the extent of such control depending upon a number of factors, such as character of government, state of civilization, classes of society and political and social ideals. States may be divided into two classes, according to whether government is completely centralized or not. In completely centralized governments, such as Great Britain, France and Italy, the right of control is entrusted to the national authorities while the local subdivisions such as counties and municipalities act as their agents. In the federalized form of government, such as the United States and Germany, the sovereign powers are parceled out between the national and local organizations, each government being independent of the other within its own especial field. With respect to growth, state control has exhibited two marked tendencies: first, that of the extension of the field of control entrusted to national authorities at the expense of the local subdivisions, and second, extension of control exercised by the government at the expense of the individual liberty of its citizens and members.

II. In general there are four distinct theories upon which the control of the state over individuals and groups of individuals is based, viz., the divine right of kings, *staatsgemacht* or force, the social contract, and social welfare. The first of these fundamental theories is aptly illustrated by the reign of Louis XIV of France and his slogan, «l'etat c'est moi.» During the past generation the theory was expounded and practised by the former emperor of Germany, Kaiser Wilhelm II, with what results the world knows too well. The second theoretical basis, *staatsgemacht* or the doctrine of force, is in practice, although not in theory, closely associated with the first, for the purpose of giving a religious sanction to the dominating influence of the state over its citizens. The third theory, that of the social contract, first formulated by Jean Jacques Rousseau in his brilliant but now generally discredited 'Social Contract,' constituted a distinct advance in political thinking and was naturally accompanied by marked improvement in national administration and in social wellbeing. The fourth theory, that of social welfare, was first enunciated by Aristotle in his 'Politics' and revived by the publicists and statesmen of England and continental Europe during the course of the 17th, 18th and 19th centuries. As an evolutionary institution, the state is held to be the natural development of the family and like it exists not for its own ends but for the benefit of its individual members. According to this theory, the state should exercise control over its members whenever and wherever such control results in the general welfare. To determine the scope and extent within which state control may be wisely exercised for the good of its citizens, representative governments have become a practical necessity.

III. During the Middle Ages and even well into the period generally denominated modern times, all the more important European nations were either absolute or limited monarchies and their governments were dominated by a group of courtiers who professedly believed in the divine right of the kings under whom they served. As the rank and file of the citizens grew in political wisdom they began to discuss the functions of government and the proper limitations of public control over private rights. The first great movement along these lines began in England in the early part of the 17th century and culminated in the overthrow of the Stuarts and the establishment of the Puritan Commonwealth in 1649. Unfortunately for the progress of civil liberty the Commonwealth proved unequal to the task imposed upon it, and it was not until the revolution of 1688 that the foundations of parliamentary government and its concomitant, a decent regard for the rights of individual men, were securely laid. From this date onward in England and the English-speaking countries the evolutionary theory of government gradually grew to be the predominating one, and with its growth the policy of economic liberalism became firmly established. As a result of the forces set loose by the American and French revolutions, despite the brief militarism of Napoleon and of the reactionary movement led by Metternich and supported by the Holy Alliance, the century beginning with the year 1776 may be characterized as the Golden Age of political and civil liberty in every domain of life. During this period mercantilism as a national policy was overthrown, the old time restrictions on trade and industry were largely abrogated, and men were more nearly free to seek their own fortunes and to live their own lives without interference by the government than ever before in the history of the civilized world.

IV. The establishment of civil and economic liberty even within the limitations set by the more progressive governments, notably those of the United States, Great Britain and France, brought results not wholly favorable to the welfare of certain classes of individuals. While the world grew rich with unprecedented rapidity, the wealth tended to accumulate in the hands of a somewhat limited few.* The rank and file, although living in comparative affluence compared with their former status, still remained poor. In the defense of the new system a great literature was created, among which Adam Smith's 'Wealth of Nations,' John Stuart Mill's 'Political Economy,' Herbert Spencer's 'Social Statics' and the 'Man versus the State,' and Bastiat's 'Harmonies Economiques,' should be especially mentioned. Notwithstanding the intellectual triumphs achieved by each of these able defenders of the new order, abundantly supported by hosts of lesser lights, the accumulative unfortunate effects of excessive economic freedom became too pronounced to be longer ignored by the various states and, therefore, beginning about 1830, the tide began to turn in favor of larger state control. To relieve the situation without at the same time changing the established order became the chief object of the political leaders in England, France, Germany and the United States. Palliative measures, such as the English Poor Law of 1834, centralizing and standardizing the administrations of charity, abolishing out-of-door relief for the able-bodied, reinstituting the workhouse test, regulating the length of hours and the conditions of employment for child labor, were concomitantly tried. Such measures, however, were largely ineffectual because they failed to strike at the root of the trouble, and naturally enough, attention was more and more directed toward a study of the causes which were producing the unfortunate and unsatisfactory results. As the investigation progressed the students of the social order almost immediately separated into two classes: first, those who deemed it wisest to destroy the existing system and inaugurate an entirely new one; second, those who proposed to preserve the fundamentals while eliminating certain non-essential features which had been found to be injurious to the common welfare.

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* King, 'The Wealth and Income of the United States' (New York 1913).

The first group of reformers almost immediately divided into two branches, the Owenites and the Marxians. The Owenites, followers of Robert Owen, established a large number of independent communistic societies, the most of which soon disappeared and the Owenites with them, although their ideals are still of large influence. The Marxians, on the other hand, although since 1848 continuously exercising large influence on political and economic theory, have never until the present war, except in a very small way, had an opportunity to give their solution a practical trial. With the downfall of the Russian Revolution and the subsequent creation of the Bolshevik government, they have established a laboratory for the practical test of their ideals. If this experiment in industrial and social reorganization should prove able to produce goods as abundantly and at the same time distribute them more fairly than the capitalistic system, the latter will for the first time in history have encountered a real competitor. The adherents of the present system will in the latter event be under a stronger pressure than ever before to institute a sufficient amount of governmental control to insure that the products jointly produced shall be fairly distributed among the factors of production.

The second group of reformers, while attempting to maintain the competitive capitalistic system for the sake of its great efficiency in production, have at the same time desired to introduce a sufficient amount of state control to secure what they considered a high degree of fairness in distribution. Their efforts have been centred upon certain critical problems of which the following are the more important:

(1) Protecting wage-earners (a) against unfavorable conditions of work and (b) against inadequate wages.

(2) Protecting consumers by (a) preventing the establishment of industrial monopolies; (b) by maintaining free competition among business enterprises, and (c) maintaining standards in the character of the goods which are produced and sold.

(3) Creating systems of taxation which, while providing abundant revenue for the uses of the government in undertaking and maintaining state control, will at the same time act as an adjusting force in the distribution of wealth.

1. (a) It was early pointed out* that while the laborer was legally free to work for whom he pleased and could refuse employment where conditions or wages were unfavorable to him, the employer could generally wait until the terms he offered were acceptable, while the laborer generally could not; that, while the employing classes were living on their capital the employees were starving; that consequently the state ought to interfere on behalf of the laborer, prescribing by law the conditions under which the work might be carried on, and in certain cases at least the wages at which the laborers might work. It was further noticed that the economic independence of the laborer was largely conditioned by the character of the industrial organization, and that wherever machinery was largely employed the relative advantage of the employer was increased. On this account regulation in behalf of the laborer began earlier in the machine trades and in those countries where machine production was most widely used. England, being the first to introduce factory production on a large scale, naturally encountered the labor problem first, and it is there that the foundations of the present system of state control in the interests of labor were laid.† In the United States the labor problem attracted little attention until after the Civil War. In 1869 Massachusetts created the first labor bureau‡ in the world, and following her example a large number of the States in the American commonwealth have established similar departments, manned by a considerable force of inspectors and administering laws which are intended to protect the laboring classes from work under conditions unfavorable to either health or morals. In the case of certain classes of labor the maximum number of hours which the laborer may work has been prescribed by law. As a result of state control in this sphere of action it has come to pass that the conditions under which the American laborer works are fairly conducive to good health, to a reasonable standard of morals and to a fairly long life.

The general establishment of the factory system, together with its necessary concomitants, mining and railway transportation, introduced a new element into the labor problem, mainly that of danger to life and limb. Until comparatively recent years it was generally assumed by those responsible for legislation that the wage-earning classes were fully capable of taking care of themselves; that placing the risk of the industry upon the employers would be sure to result in carelessness on the part of the operatives and high cost of production for the goods sold. It was, therefore, the established rule of law in all countries that the employer would be held responsible only for damages to life and limb due to his own negligence, while the employees must suffer those resulting from their own lack of care. To secure redress for injuries due to the carelessness of the employer the employee was obliged to bring a suit at law, stating the cause for his complaint and offering evidence to show that the employer was legally responsible for the accident that caused the damage. In the litigation that arose over such cases the judges in the absence of specific statutes to the contrary developed a series of common-law doctrines which to a large extent modified the original theory of the law. These doctrines are: that of contributory negligence, of assumption of risk, and the fellow-servant rule. Under the common law the employer could be held liable only when the accident was due to his own fault or neglect, but not when the negligence of the employee contributed to the accident or when the accident was due to a natural risk of the employment, nor when the accident was due to the act of a fellow-servant. Under these conditions the employer was legally responsible for damage resulting from certain classes of accidents; but even when legally responsible it was not easy for the injured employee to prove his case and collect compensation for the damages. Moreover suits against the employer were not conducive to pleasant relationships and gradually it became the custom for the employer to take out liability insurance under which the insurance companies undertook to defend all suits as well as to pay all damages incurred. Thus, while the liability to pay damages on account of accidents was a real factor in the cost of production, viewed from the employers' standpoint, comparatively little of this expense filtered into the pockets of the employees as compensation for their injuries. With the growing appreciation of the unfairness of the common law, the social reformers of the revolutionary type proposed and finally secured remedial legislation by the passage of the so-called workmen's compensation acts, by virtue of which the common-law rules were largely and in some cases fully abrogated, and in their place a system of direct compensation for various accidents substituted. In this movement Germany took the lead, establishing the first system of accident compensation on a large scale in 1884.* Since that date 48 other countries, including the United States, have adopted the same national system, and in the United States 35 of her Commonwealths and Territories had, on or before the first of January 1917, enacted either compulsory or elective compensation acts. In general, the administration of the compensation acts is entrusted to a commission, that established in Wisconsin in 1911 being generally regarded as an efficient type.

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* Owen, 'Observation on the effect of Manufacturing System, etc.'

† 3 & 4 Wm. IV. c. 103. 16 & 17 Victoria, c. 54.

‡ 3 Dec. 1913 there were 42 such bureaus.

1. (b) State control of wages has for reasons that are readily appreciated made much less progress than public regulation of the conditions under which the laborer works. The movement of establishing public control of wages began in New Zealand in 1894, and for 15 years thereafter was confined to the countries in that corner of the globe. Since 1909, when the first minimum wage act in any of the older countries was passed by the enactment of the Trade Boards Act of October 1909, in Great Britain, the system has been extended in that country to coal mines by the act of 29 March 1912, and in the United States to various lines of work in certain of the commonwealths. The arguments relied upon to defend the system of minimum wages are similar in their nature and in their validity to those advanced in favor of the compensation acts, namely, the failure of competitive forces to insure a fair distribution of wealth for those engaged in certain occupations. While no method has yet been devised by which a reasonable wage may be determined by law it has not proven impracticable to establish minimum wages in the sweated industries on the basis of wages for similar work in the non-sweated industries. The object and the natural results of minimum wage legislation then is found to be the restoration of normal competitive conditions by state action in those industries where the *laissez-faire* system has for reasons that are sometimes obscure, but more often patent, failed to work.

2. (a) From the age of Elizabeth, when the English patents of monopoly threatened to become a prominent feature of the Crown's prerogative, up to the period of the Civil War in the United States, competition between industrial and commercial enterprises was sufficiently active and at the same time sufficiently moderate to prevent the growth and development of industrial monopolies in a large way. Immediately after the conclusion of the Civil War conditions began to change, the new conditions tending to promote the growth of large combinations and consolidations in various fields of industrial activity. The first of these conditions was economic, the second moral and intellectual. With the development of steam as a motive force, the larger factories were found to be more efficient as producers of standardized commodities, and a process of elimination thereupon followed, the smaller factories giving way to the larger ones. At the same time the proprietors and managers formerly abnormally hostile and suspicious began to get acquainted with each other at the clubs and at informal gatherings, and as a result of this acquaintance they discovered that, contrary to their former beliefs, co-operation was oftentimes more advantageous than open and continuous warfare. As a result of these two concurrent forces the consolidation movement began first among the railroads and later among the industries. The railroads began consolidating even before the Civil War, while the first of the great industrial consolidations began with the union of the interests of the Rockefellers, Andrews, Harkness and Flagler, in 1867. From that date until 1904, when the government became active in controlling the formation and operation of various kinds of combinations, the consolidation movement was uninterrupted in its progress when measured either by the number of enterprises united or by the size of the resulting organizations. The trust movement began to attract public interest in certain sections of the country as early as 1877, although it was not until 10 years later that the problem became a national one. As a result of the investigations made by Congress in connection with the preparation and enactment of the Interstate Commerce Act of 1887, public attention became more intensely focused upon consolidations, their nature and import, and after two years of discussion the Sherman Act of 1890 was enacted into law. During the same period the State legislators were engaged in investigating combinations and in passing certain acts to protect intrastate business from monopolistic enterprises, so that by the end of the 19th century 32 of the American States had anti-trust acts on their statute books. Notwithstanding the legislation prohibiting such organizations, the trusts continued to develop, and it was not until the creation of the Bureau of Corporations, 14 Feb. 1903, and the simultaneous adoption of a vigorous administrative policy by the Department of Justice, that the trust movement began to abate. Since 1903 a considerable number of combinations have been

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*Workmen's Compensation Laws of the United States and Foreign Countries, Washington, D. C., Bureau of Labor Statistics.

dissolved, several of the corporate consolidations have been disintegrated and at the same time the formation of new combinations and new consolidations has generally ceased. When America entered the World War, suits then in progress, directed against several of the larger consolidations, were by action of the Supreme Court, on motion of the Attorney-General, postponed for the duration of the war. It may be inferred, as a result of the better knowledge of co-operative effort engendered during the World War, that the policy of the administration and of the courts will be affected in such a way that decisions like that rendered in the Northern Securities case of 1904 will no longer be possible. On the other hand, combinations will be judged from the efficiency standpoint and government control established in such a way that their efficiency may redound to the common good.

2. (b) In 1914 an important change in the laws relating to combinations and competitive methods of doing business was introduced by the repeal of the act creating the Bureau of Corporations, and the enactment of two additional statutes for the better regulation of the activities of business enterprises. The first of the two acts was that creating the Federal Trade Commission*; the second, the Clayton Act.† The result of the legislation of 1914 was to establish a commission of five persons in place of the Bureau of Corporations and to impose upon the newly-created commission certain additional duties, of which the most important are: the enforcement of fair methods of competition‡ and the establishment of certain standards by which fair competition may be judged. During the year ending 30 June 1918, the Commission received 332 complaints charging unfair competitive methods or other violation of the acts under which they were operating. Since the creation of the Federal Trade Commission much more attention has been given to maintaining fair competition among competing business enterprises and less to the investigation of the combinations of various kinds. If, as confidently believed by many students of industrial conditions, the establishment and maintenance of fair competitive conditions by government action is efficacious in preventing many types of combinations, then the problem of industrial monopoly for the immediate future is partially if not completely solved.

3. While the state has always either directly or indirectly exercised its sovereign right of taxation for the purpose of providing revenue to meet its expenses, it was not until recent years that tax systems were designed with the avowed purpose of controlling the production and the distribution of wealth. Taxes for the purpose of controlling production, either directly or indirectly, are illustrated by those on beverages, narcotics and certain drugs. Sometimes the article itself is taxed, sometimes the privilege of selling, as license fees for saloons and other articles whose consumption it is desired to check. Another example of ancient lineage is the tax on importation or exportation. In this case production is checked in one country and promoted in the other, the ultimate effect of the tax being determined by the rate of the tax and by the elasticity of the demand. The international economic effects of State control through import duties is aptly illustrated by the historical evolution of Great Britain and Germany. The former nation has followed the policy of *laissez-faire* with respect to foreign trade, the latter that of public control through the tariff. Great Britain became a specialist in manufacture with a consequent large development of international commerce. Germany became an all-around producer, a farmer, a manufacturer, a trader and a financier, good in each without being pre-eminent in any. When the World War came on, England's most vulnerable spot was her dependence on foreign trade for food as well as for a portion of her raw materials, and Germany, well knowing this, launched her submarine campaign as her best line of attack. To parry this offensive, England was obliged to maintain at her peril her acknowledged mastery of the seas in order that her merchant marine might bring the requirements which her position as a specialist daily demanded. Germany on the other hand was able to withdraw from the seas since her diversified powers of production were sufficiently extensive to provide for her major wants for a considerable period of time. In view of the experience of England and Germany some publicists have argued that taxation through tariffs ought to be more widely used for the purpose of forcing a nation to become more largely self-sufficient in the production of the essentials of a complete national life.

Taxation for the purpose of controlling the distribution of wealth has long been understood by economists and statesmen but, for reasons that are patent, little used until the recent World War furnished the necessary stimulus by imposing burdens upon the participating governments so stupendous that the historic methods of raising revenue were found to be entirely inadequate. To find additional revenue without at the same time imposing burdens of crushing weight upon the poorer classes of society, rates of taxation, it was thought, must progressively increase with the size of the income. As a result of the war, then, we have a new system of taxation in actual operation, one whose ultimate effect is to change profoundly the distribution of wealth by relieving certain of the poorer classes largely if not entirely from the paying of taxes based upon incomes and imposing far weightier burdens than ever before upon those whose incomes exceed the requirements of rational life.

V. War, by emphasizing the importance of concerted action, strengthens the hands of those who believe in an efficient and extensive system of state control, and at the same time and for the same reason weakens the cause of those who favor the policy of economic liberalism. On this account the period beginning with the Civil War of 1861 and terminating with the Franco-Prussian War of 10 years later marks a turning point in the growth of state control. It was generally conceded that the Prussian system was efficient and the results of the three wars by means of which Prussia became the dominant force in central Europe argued so eloquently for strongly centralized governments acting under wide powers that even England and the United States began to study, to admire and then to copy the style of government which they had previous to this period condemned in theory* and avoided in practice.† But even though yielding somewhat to the adherents of the Prussian system the rank and file of the English and American people resisted the proposed innovations, and when the World War came in August 1914, both nations, Great Britain and the United States, were still predominantly exponents of a modified *laisses-faire* system. Germany on the other hand, partly as a result of certain habits and traditions and partly because of the fact that she was always either engaged in, or preparing for war, continued to extend the activities of her government so widely and so deeply that no private interest and no individual was left untouched. By this process of prussianization, individuals instead of being left free, either partially or wholly, to pursue their own courses as it seemed best for their own interests, were forced to shape their activities in accordance with the policies determined upon by the government of the day. Industries that were thought to be essential for success in war were fostered and protected by subsidies or other favoring legislation. Economic and social institutions were encouraged and established or discouraged and prohibited according as they were thought to be elements of national strength or causes of national weakness. The general results of this policy became evident immediately the World War was well under way. England and the United States, strong in peace, were weak in war. France, a nation historically opposed to extensive state control, had so far copied the Prussian system as to maintain a formidable standing army while otherwise following the policy of England and the United States. France therefore was able to hold the German forces in check while England and the United States, the pronounced exponents of economic liberalism, began to prepare, the former because she became a participant at the outset, the latter because it early became evident that she might be involved at any instant. Both England and the United States thus found it necessary in the interests of national efficiency to abandon their historic methods of managing their domestic affairs and substitute therefor the one by which Germany had so completely unified her national resources, men and materials, labor and capital, and turned the machine thus created upon those who threatened to block her path in her quest for world empire.

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* Act of 26 Sept. 1914, 38 Stat. 717.

† Act of 15 Oct. 1914, 38 Stat. 730.

‡ Consult Stevens, *Political Science Quarterly*, June 1914, p. 283 et seq.

To accomplish the transition from a *laissez-faire* government to a system of complete State control, England, France and the United States followed similar paths. To secure adequate transportation facilities for the national needs it was early perceived, especially in England, that the railway, shipping, telegraph and telephone, all these instruments of communication, must be operated as units under the direct control of the central governments and with small delay the required authority was granted the several administrations. Communication through railways, ships, telegraphs and telephone is, however, only an instrument of production, and production of arms, of food and of clothing, in the necessary quantities and of the proper kinds were equally essential to the successful prosecution of the war. Factories that had been producing non-essentials must be made to produce essentials and farms and mines must join the factories in furnishing raw materials, food, minerals and other necessary articles for an efficient life. To secure control over production, factories and mines were commandeered, enlarged or closed down as the situation demanded. Having secured control of production and communication, a third step became natural in all cases and necessary in some, that of control over distribution by means of which material and labor available for use could be divided among men and industries in such a way that each unit of productive power would be most useful to the nation without regard to any other factors. In carrying this policy of completely unified state control into operation, the United States adopted a somewhat different plan from that followed in England. Whereas in the latter country authority was largely centred in the ministry of munitions, in the former it was divided up among a considerable number of administrative organs, partially independent although in general centralized under the immediate control of the President. Thus where England had her ministry of munitions, the United States had the food and fuel administrations, the emergency fleet corporation, the war trade board, the war industries board, the federal railway administration, the national war labor board, the labor policies board, and the United States employment service, all acting as separate entities except as unified by the common control exercised by the chief executive. By such means, the industrial activities of all classes of citizens in the allied countries were soon after the beginning of the war as completely and it is probable, as efficiently controlled as in that great prototype of state control, Germany herself.

Now that the war is over and peace has come again the question as to whether economic liberalism has been abandoned permanently or only temporarily is the most important one now before the western world. The ease and facility with which the allied nations transformed themselves into fighting machines, the initiative and resourcefulness displayed by industrial leaders and working men in conducting to a successful conclusion a war for which they had not directly perpared, furnishes strong if not conclusive evidence that the economic system under which they have been living and prospering in the past possesses merits of such a character that it should not be lightly discarded in favor of one that has been proven to be provocative of wars and destructive of individual initiative and individual character.

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STATE AND CORPORATION. See CORPORATIONS, LEGAL.

STATE COURTS. See COURT.

STATE DEPARTMENT, one of the 10 executive departments of the United States government. It is presided over by the Secretary of State (q.v.), who is a member of the Cabinet, and next in line to the Vice-President for the Presidency. The department was established by act of Congress, 27 July 1789.

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* Pollock, 'History of the Science of Politics.'
† Dicey, 'The English Constitution.'

Through this department communication is made between the United States government and any of the States or any foreign country. The department has charge of the great seal of the United States; of all ambassadors and consuls, and in its custody are all engrossed copies of the laws of the United States and of all treaties. The Secretary of State publishes all statutes and resolutions of Congress and all proclamations of the President of the United States. Under his charge, too, are all passports issued to American citizens visiting foreign countries; and all warrants for the extradition of criminals for delivery to foreign governments. It is the duty of the Secretary of State to make a report of the activities of his department annually as to its conduct of the foreign relations of the United States. There are three assistant secretaries in the department and a large force of clerks, translators, librarians and other employees. Bigelow, John, 'Breaches of Anglo-American Treaties' (New York 1917); Butler, C. H., 'The Treaty-making Power of the United States' (New York 1902); Corwin, H., 'The President's Control of Foreign Relations' (Princeton 1917); Foster, J. W., 'A Century of American Diplomacy' (Boston 1900); Hasse, A. R., 'United States Documents Relating to Foreign Affairs' (Washington 1914); 'History of the Department of State' (Washington 1901); Johnson, W. F., 'American Foreign Relations' (New York 1916); Moore, J. B., 'American Diplomacy' (New York 1905). Consult also the various reports of the secretaries of State.

STATE EXECUTIVE. See EXECUTIVE.

STATE FORESTRY. See FORESTRY IN THE UNITED STATES.

STATE GOVERNMENT, American. "The States," said Lincoln, "have their status in the Union and they have no other legal status." The powers reserved to the States, their obligations to one another and to the Union, and the obligations of the Union to them: all are provided for in the Constitution of the United States. The people of the United States under their National Constitution have assumed the obligation of guaranteeing to each State the republican form of government, of protecting it against foreign invasion and domestic insurrection and of securing to its citizens all the rights and privileges of citizens of the United States. Each State, on the other hand, is obliged to respect the supremacy of the Constitution, the laws and the treaties of the United States and to permit its government to act for certain purposes as the agent of the government of the United States. In general, however, the government of the United States operates directly upon the people of the United States and there is no occasion to rely upon the State governments for the accomplishment of national purposes. The States are also obliged to give full faith and credit to one another's public acts and records, to extend equal privileges to one another's citizens, to return fugitives from justice and to submit controversies among themselves, if not settled by mutual agreement, to the arbitrament of the Supreme Court of the United States. The power of the national government, however, to enforce some of these obligations is defective.

Powers of the States.— The powers reserved to the States may be said in a general way to include all the powers of free and independent States, except: (1) those which are expressly delegated to the government of the United States or are reasonably implied in the grant of the expressed powers; (2) those which are expressly prohibited to the States; and (3) those which, though neither expressly delegated to the national government by the Constitution nor prohibited by it to the States, are reserved to the people of the United States. Of the powers expressly delegated to the national government some, such as the power to govern the territories of the United States or the District of Columbia, do not directly affect the powers of the States. Some of those, however, which do not directly affect the powers of the States, such as the powers to tax, to regulate interstate and foreign commerce, and to make treaties, may be used in such a manner as indirectly to affect very strongly the exercise by the States of their reserved powers. Others, such as the power to establish a uniform bankruptcy law, may not limit the powers of the States unless Congress expressly so orders. Some powers, such as the power to coin money, are re-enforced by express prohibitions upon the States. The other express prohibitions upon the States are of varying importance. Probably the most important, besides those intended to give the national government exclusive control of foreign relations and the conduct of war, are those incorporated in the Constitution at the close of the Civil War, notably the provision that no State shall deprive any person of life, liberty or property without due process of law nor deny to any person the equal protection of the laws. Finally, the reservation of certain rights to the people of the United States by the 10th amendment, adopted in 1790, prevents the States from exercising any powers which, though not expressly delegated to the national government nor prohibited to the States, are essential to the preservation of the sovereignty of the Union.

The people of the several States are subject to the sovereignty of the people of the Union, but the people of each State are equal to those of any other before the law of the Constitution. Congress may admit new States to the Union, imposing such conditions as it may deem suitable as the price of admission, but once within the sacred edifice a new State becomes the peer of the others. The powers which the States may exercise, though limited, are nevertheless very extensive and highly important. They include among others the following: (1) the power to establish and maintain organized governments, State and local, subject to the limitation that they be republican in form; (2) the power to regulate the suffrage, both in State and in national elections, subject to the limitation that no citizen be deprived of the vote on account of race, color or previous condition of servitude; (3) the power to levy and collect taxes, except upon the instruments of the national government and upon interstate and foreign commerce; (4) the police power, including the power to enact all measures restricting the personal freedom of the individual or his use of his property, which may be necessary and proper for the preservation of the peace, the protection of the public health and morals or in any other way for the promotion of the common welfare, subject to the limitation that no person be deprived of life, liberty or property without due process of law or denied the equal protection of the laws; (5) far-reaching powers to deal with education, religion and the supply of public services of all kinds, except the comparatively few, such as the post office, which are placed in the hands of the national government; (6) the power to create corporations and trusts; and (7) to deal with the whole subject of private law, including the power to regulate the vital institutions of modern civilization, such as the family and the institution of private property. Despite the growing centralization of government in the United States, evidenced by the adoption of the 18th Amendment to the Federal Constitution, the so-called prohibition amendment, the powers of the State remain, as they were in the beginning, more important than those of the Union, so far as concerns the regulation of the daily life of the people.

Rights of the States.— The basis of the State is the Constitution of the United States, but the basis of State government is the State constitution. The original State constitutions, adopted at the time of the Revolution, contained (1) an enacting clause, (2) a frame of government, (3) a schedule, and (4) in most cases a declaration of rights. In some cases there was also a preamble, setting forth the reasons for the adoption of a State constitution and intended to justify the overthrow of the former government. The declaration of rights ordinarily comprised a statement of the political philosophy of the Revolution and of the civil rights claimed for the people. The political philosophy was not radically different from that set forth nearly a hundred years earlier by John Locke in justification of the English Revolution of 1688. The civil rights were of two kinds: (1) abstract rights, such as the right to freedom of speech and of the press; and (2) concrete rights, such as the right to the writ of *habeas corpus* and to trial by jury. Practically it was upon the latter kind of rights that the former were dependent for their force. The declarations of abstract rights, to be sure, had their effect upon public opinion and thereby indirectly upon the conduct of government, but the system of trial by jury enabled the people to impose a direct check upon the acts of those in authority. The schedule dealt with such matters as the boundaries of the State and the transition from the provisional to the constitutional government. The frame of government was a body of rules for the organization of the government and the division of powers between its several branches. It also regulated to some extent the conduct of elections and the procedure of the legislative, executive and judicial departments. The enacting clause expressed the purpose of the Constitution and set forth its sanction in the will of the people. The existing State constitutions contain, in addition to the foregoing, a good deal of ordinary legislative matter, inserted from time to time by State constitutional conventions for the purpose of putting it beyond the reach of ordinary legislatures. Some of this matter is important, such as measures for the regulation of the liquor traffic, but much of it is comparatively trivial.

The Suffrage.— The fundamental organ of government in the States is the electorate. The right to vote was originally conferred only on those who were deemed to have a sufficient interest in the welfare of the State and who were otherwise fit. Manhood suffrage did not exist. During the first half of the 19th century it was established in substantially all the States, so far as white men were concerned, and after the Civil War the ballot was extended to the freedmen. Meanwhile a reaction had set in against the principle of manhood suffrage. First, literacy qualifications were established in several northern State to exclude uneducated foreign-born voters and then qualifications of various kinds were established in the southern States to exclude Negro voters. At present qualifications designed to restrict the franchise to those who are deemed fit exist in just half the States. The extension of the ballot to women on the same terms as to men began in the territories of the west. Equal suffrage for men and women now exists in more than a third of the States, and in several others women may vote for presidential electors and most local officers, though not for governor and members of the State legislature. There is a larger number in which they may vote in certain local elections, particularly in public school elections. The 19th Amendment to the Federal Constitution will, however, put an end to disfranchisement on account of sex. In most States the voters must be registered, at least in the larger cities, in order to exercise their right. In most States also the ballots are printed and elections are conducted by public officials at public expense. The collection and expenditure of money by candidates for election and by political parties is generally regulated by law and corrupt practices are carefully defined and prohibited.

State Legislatures.— The State legislatures consist of two branches. The lower branch, generally called the house of representatives, contains as a rule from two to three times as many members as the upper, which is always called the Senate. The number of members of the lower branch ranges from 35 in Arizona and Delaware to 402 in New Hampshire. The number of senators ranges from 17 in Delaware to 63 in Minnesota. In most States the county is the basis of representation in both branches of the legislature. Various methods of apportionment have been adopted for the purpose of adjusting representation more or less accurately to population, but in many States there is deliberate discrimination against the larger cities in the apportionment of members. The term of members of the lower branch is two years in almost all States, and that of senators in the majority of States is four years. Members of the legislature are paid in all States. In most States the rates are low; in some they are no more than the wages of unskilled manual laborers. In most States the legislature meet regularly once in two years and the length of the session is generally limited to 60 or 90 days. Both the powers and the procedure of the legislatures are more or less strictly limited by the State constitutions. The legislative powers are conferred equally on both branches, with the exception that money bills must originate in the lower. The senates are also entrusted with certain executive and judicial powers, notably the power of confirming executive appointments and of trying impeachments when brought by the lower branch. In practice the latter power has proved of little importance, whilst the former has made the Senate an exceedingly important factor in executive affairs in all States where the executive has much patronage. In general the working of the legislatures has been the least satisfactory feature of State government.

The Governor.— Most of the State constitutions declare that the governor shall be the chief executive magistrate, but few constitutions actually confer on him the powers necessary and appropriate for a chief executive. His principal associates are generally elected, like himself, directly by the people, and for terms as long as his own. It is consequently impossible for him to direct them in the conduct of their offices. Though in all States the governor may appoint some of the department heads and members of administrative boards and commissions, his power of removal is often surrounded with restrictions which render him more or less of a figurehead in the actual conduct of administration. The importance of the office of governor results mainly from its political powers, notably the power to recommend measures to the consideration of the legislature and to veto bills which though passed by the legislature are objectionable. In most States the veto power extends to the veto of items in appropriation bills, thus giving the governor a specially strong position with respect to appropriations. The State constitutions further provide that an executive veto may be overridden by special majorities in the legislature, but in several States, where a two-thirds majority of all the elected members in each branch is required to pass a measure over a veto, it is exceedingly difficult in practice to do it. Moreover in States where the length of legislative sessions is strictly limited, most of the measures are passed in the last days of the session and the executive veto is not exercised upon them until after the session has closed. Thus the governor has come to be the chief legislator rather than the chief executive of the State.

Administrative Agencies.— The expansion of the administrative activities of the States in recent years has caused a great increase in the number of separate administrative agencies. In New York there were more than 150 separate administrative agencies in 1915 and in several States there were over 100. Some of these separate administrative agencies, such as tax commissions, railroad and public service commissions, industrial commissions and departments of health and various special boards and offices charged with the administration of laws for the regulation of industry and the protection of labor, exercise important powers. In practice they are much more subject to control by the courts than by the nominal chief executive of the State. In a few States appointments to minor places in the administrative service are made from lists of applicants certified as competent by State civil service commissions, but in most States appointments are made by the governor or the department heads at their discretion, except so far as limited by the requirement of senatorial confirmation or by special conditions laid down by law. In general, political considerations outweigh considerations of fitness too often for the good of the public service. Economy and efficiency in State administration tend to suffer from neglect.

The Judiciary.— The State judiciary are elected directly by the people in three-fourths of the States. In the others they are appointed by the governor or elected by the legislature. In the central and western States popular election is universal. Terms of Supreme Court judges vary from two years in Vermont to 21 years in Pennsylvania, but in most States the term ranges from 6 to 12 years. In Massachusetts the judges hold office during good behavior, like Federal judges. Salaries, as in the case of other State elective officers, are in most States comparatively low. Terms of judges of lower courts are generally shorter and salaries lower. The organization of the courts is generally regulated in the State constitutions. In most States it is highly decentralized. Magistrates' courts of various kinds exercise a limited jurisdiction in the towns and cities, above them in most of the States are the County Courts, and between the latter and the highest court of the State there are as a rule one or more intermediate courts with varying original and appellate jurisdictions. The States are generally divided into fixed judicial districts in order to localize these intermediate courts, and a separate court with a prescribed number of judges is organized in each district. The resulting judicial system is highly inelastic and not infrequently uneconomical and inefficient. On the whole, however, the working of the judicial system is more satisfactory than that of either of the other principal departments of State government.

Amendment of State Constitutions.— Two different modes have been provided in almost all States for the revision and amendment of State constitutions. One is by the constitutional convention. The organization and procedure of constitutional conventions is far from uniform. In some States a convention may be called by the legislature at any time. In others the approval of a majority of the voters is required before a convention may be called. In some States the number and manner of election of delegates to a convention is regulated by the constitution. In others the legislature may determine the numbers and manner of election. Most conventions, however, are actually organized upon the model of the lower branch of the legislature. In some States a convention may put the revised constitution, when agreed upon, in force without further reference to the people. In most States reference to the people is required or is practised without any special requirement. The other mode of constitutional change is by the proposal of specific amendments by the legislature, subject to approval by a majority of the voters, In some States a proposed amendment must be adopted by two successive legislatures before it can be submitted to the people. In others adoption by one legislature is enough. In all States the legislature must approve a proposed amendment by more than a bare majority vote. Recently beginning in Oregon in 1902, a fourth of the States have established another mode of constitutional amendment not requiring action by the legislature or by any other representative body. This is the so-called constitutional initiative. Upon petition of a prescribed number of voters a proposed amendment is placed directly on the ballot and may be adopted by a majority of the voters.

The Initiative.— A larger number of States, beginning with South Dakota in 1898, have established the statutory initiative. Upon petition of a prescribed number of voters an ordinary legislative measure may be proposed for adoption directly by the voters. This procedure for direct legislation by the people is generally associated with the direct popular referendum, a device by means of which the voters may veto a measure which, though enacted by the legislature, is objectionable to them. In 1919 the statutory initiative existed in 19 States and the popular referendum in 21 States. In some of these, notably Oregon, California, Arizona and Colorado, the initiative and referendum have been freely used in recent years.

Party System.— Actual government in the States is profoundly affected by the existence of the party system. In most of the States the political party is recognized by law as an instrument of government. In all of them the nomination of candidates for elective office is entirely in their control, and to a considerable extent the nomination of candidates for appointive office is practically vested in the leaders of the party organizations. A political party is commonly defined as an association of voters which at the last preceding election polled not less than a certain number of votes, or a certain percentage of the total vote for some representative office. This qualification is usually easy to meet. A political party, when recognized, becomes entitled to the exclusive use of a party name and, in most States where illiterates may vote, also a party emblem, which assists the illiterate in marking his ballot. The number of recognized parties varies, but in most States is at least three and in some as many as six. Only two parties, however, are anywhere of major importance, and in many States one of these is generally much more successful than the other. In most States the major parties are now required to make their nominations at primary elections, which are conducted by public election officers at public expense. In some of these States the voter may attend the official primaries and help nominate the candidates of any party he chooses without divulging his party affiliation. In the greater number of States, however, he must declare his party affiliation before he can participate in the nomination of candidates, the voters' declarations being checked by a system of party enrolment. The organization of the parties also is commonly regulated by law, and the members of the party committees, like the candidates for public office, are selected at the primaries. The regulation by law of the methods of nomination has been accomplished for the most part within the last quarter of a century, and the establishment of the direct primary system has been the work of the last 15 years. Taken together with the introduction of the Australian, or secret official ballot, the legal recognition of parties and the regulation of their proceedings has brought a great improvement in the conduct of elections and in the general tone of politics in the States. See APPOINTMENTS, FEDERAL, STATE AND LOCAL; APPORTIONMENT; APPROPRIATIONS, AMERICAN SYSTEM OF; BUDGET; FEDERAL GOVERNMENT; LEGISLATION; LEGISLATURE.

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STATE GOVERNMENTS, Characteristics of. As a federation, the government of the United States comprises the national government controlled by its legislative and administrative departments, and the separate governments of the 48 States of the Union. Under the national Constitution, each State may organize its government system as it pleases, but it must be republican in form, or organized so that the will of its citizens can be ascertained and enforced. When forming the Union under the Constitution of 1787, the 13 original States reserved to themselves certain characteristic rights, which the Federal government is bound by fundamental law to respect. These can be reduced only by amendments to the Constitution. Nearly all forms and powers of government were comprised in the sphere of State authority with the exception of those relating to foreign affairs, army and navy, interstate commerce, coinage and the tariff, the powers of the national government being specified in the fundamental law. The individuality, the dignity of the sovereign State, the only government officially known to foreign states, is represented by the national government possessing the powers involved in international relations, including war and diplomacy. In domestic matters, general economic interests are under its control. By contrast, the States control the mass of governmental power in respect to life, property and education and legislate freely on property rights, occupations, crimes, charities, sanitation and schools. Except import and export taxes, each State may levy what taxes it pleases; and it may legislate for the general welfare of its citizens subject only to the few restrictions of the national Constitution. The differences of taxation and legislation in each State form their distinctive characteristics. See STATE; TAXATION; UNITED STATES — STATES CONSTITUTIONS; and articles on the different States of the Union.

STATE MILITIA. See MILITIA.

STATE SYSTEMS OF EDUCATION. The government of the United States has never exercised control or supervision over public education. The American people were not prepared for a national system of education when the foundation of the national government was established by the adoption of the Constitution of the United States. That document does not, therefore, contain a single provision in relation to the subject of education. There was not that common mutual interest in the social, industrial, commercial and political relations between the several States which later gradually developed among them. There was much prejudice and even fear against the power of a centralized national government. The idea of State control in all matters possible prevailed to a large extent among the people of all the States. While the subject of education was not regarded generally by the national leaders as one to receive their consideration, there were men in all parts of the country who recognized the vital need of establishing schools for the education of all children. Even in colonial days this idea had strong support in many of the colonies, notably in Massachusetts, New York, Connecticut, Rhode Island, New Jersey and Pennsylvania. The Dutch settlers brought with them the ideas of governmental institutions which prevailed in Holland. In the Dutch settlements schools had generally been established. The English Dissenters also brought with them their beliefs on social problems and they also organized schools in their settlements. When States were organized and institutions were being developed to meet the social needs of a progressive people, the influences which had been created by these forces were bound to be a potent factor. In these States, therefore, the establishment of schools received early consideration. The British evacuated the City of New York in November 1783, and within two months from that time Governor George Clinton was urging upon the legislature of New York the need of schools in the following language:

> "Neglect of the education of youth is among the evils consequent on war — perhaps there is scarce anything more worthy your attention, than the revival and encouragement of seminaries of learning; and nothing by which we can more satisfactorily express our gratitude to the Supreme Being for his past favors; since piety and virtue are generally the offspring of an enlightened understanding."

Gradually each State by legislative enactment either continued the schools established by the colony or authorized the establishment of new schools. In many cases special acts conferred upon a particular community the authority to maintain a school. The general laws authorizing and requiring all communities in the State to provide schools were enacted. State aid was gradually extended. Thus through a process of legislation there was gradually established a system of education in every State in the Union. By this method the accepted policy of the nation in relation to public education was adopted and that policy is the voluntary action of each State in organizing and maintaining a State system of public education. When the practice of a State upon a subject has been continued for a long period of years so that such practice becomes the fixed policy of the State, the people of the State usually express that policy in their State constitution. When new States are admitted to the Union such States adopt a constitution, and it has been the settled practice of the newer States to incorporate in their constitutions a provision requiring the maintenance of a system of free schools. As the constitutions of older States have been revised a provision relating to education has been incorporated in such constitutions. The State of New York, which enacted a general law establishing a State-wide school system in 1812, did not include an article in her constitution in relation to education until 1894.

Nearly every State in the Union has written in its constitution a provision requiring the maintenance of a system of free common schools. These constitutional provisions are similar to the following:

> MINNESOTA (sec. I, art. 8).— "The stability of a republican form of government depending mainly upon the intelligence of the people, it shall be the duty of the Legislature to establish a general and uniform system of public schools."
>
> OKLAHOMA (sec. I, art. 13).— "The Legislature shall establish and maintain a system of free schools wherein all the children of the State may be educated."
>
> NEW YORK (sec. I, art. 9).— "The Legislature shall provide for the maintenance and support of a system of free common schools, wherein all the children of this State may be educated."

It must not be inferred that, because the national government has not assumed direction and control of education throughout the country, it has not been interested in public education. On the contrary, the government has given aid in various forms to the support of education in the States for nearly a century.

In 1836 the national government distributed several million dollars of surplus funds among the States. In 1862 the National Land Grant Act was passed. This was followed by the Second Morrill Act, the Nelson Law, the Adams Law, the Smith-Lever Law and, in 1917, by the Smith-Hughes Act. The national government has given for public education nearly one hundred million acres of land. It has also established various agencies which exercise functions in relation to the educational affairs of the country. The Bureau of Education in the Department of the Interior and the Federal Board for Vocational Education are two important agencies dealing with education. It appears that more than 80 other agencies, which have official relations in one way or another with the school systems of the several States, have also been established by the national government. There is now pending before Congress a bill creating a national department of education, whose head shall be a member of the President's Cabinet and known as Secretary of Education. Notwithstanding this aid to education on the part of the national government, and the activities of the nation in promoting the interests of education throughout the country, education in America remains subject to the control and direction of the several States. Even under the terms of the bill pending in Congress the control of education by the several States remains undisturbed.

Under this general plan which has been followed in administering educational affairs, there has grown up in America a fundamental principle of school administration which is becoming more pronounced and more controlling year by year. That principle is that education is a *State function* and that all the schools of a State constitute *one system — a State system*. In other words, the schools maintained in a city or a school district are not independent, detached systems, but they are a part of the State system and subject to general control and direction by the State. The fact that local officers are selected by popular vote or are appointed by a mayor does not make these officers local or city officers, or the schools local or city schools. These school officers are officers chosen by a method determined by the State and for the performance of State functions, and the schools are a part of a State system.

There is probably no question related to the administration of public schools which is of greater importance at the present time than the distinction between local control and State control. All powers exercised by local school officers in the administration of schools are powers delegated by the State through legislative enactment and may be modified or revoked by the agency which conferred them. Local control often means municipal control, and the greatest obstacle that has stood in the way of educational progress in the cities of this country has been the control or domination of school affairs by municipal officers. Where such domination has existed the schools have very generally been administered upon the same political and partisan bases which have governed the administration of municipal affairs. In several of the leading cities of the country the mayors and other municipal officers are attempting to override the statutes regulating the administration of the schools, to obtain control of the management of such schools and to establish the general policy under which they shall be governed. This interference of municipal officers has resulted in legislation in many States to make more secure the right and the authority of school officers to administer the schools.

The decisions of the courts have uniformly, in the several States, sustained the cardinal principle that education is a matter of general concern to the State and subject to the State's general control and direction.

An examination of the leading cases decided by the courts of the several States in relation to the control and supervision of public education will show that the following fundamental principles of school administration have been clearly established.

1. Public education is a State function or a subject under the control and supervision of the State. Systems of education which have been established in the several States but administered by local officers in the several localities of the State are State systems.

2. The officers chosen to administer laws enacted to operate and maintain a school system in various localities throughout the State are not local officers, neither are they town, village or city officers but public or State officers performing duties for the public at large.

3. When the officers of a city are authorized to perform some duty in connection with the operation or maintenance of public schools, as the appointment of members of a board of education by the mayor or the collection of taxes for school purposes by a city treasurer, such city officers do not act, in the discharge of such duties, as municipal officers but as special officers exercising a power devolved upon them to administer a function of government for the benefit of all the citizens of the State.

4. The laws relating to the schools of a city which are written in the charter of such city are a part of the school laws of the State and not a part of the charter or law of the city.

In support of these fundamental principles the following excerpts are taken from leading court decisions:

> "The power of the States to establish and maintain systems of common schools, to raise money for that purpose by taxation, and to govern, control and regulate such schools when established is one of 'the powers not delegated to the United States by the constitution nor prohibited by it to the States; and consequently it is reserved to the States respectively or to their people." (Marshall v. Donovan, 10 Bush [Ky.] 690).
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> "It is apparent from the general drift of the argument that the learned counsel for the defendant is of the opinion that the employment of the teachers in the public schools and the general conduct and management of the schools is a city function in the same sense as it is in the case of the care of the streets or the employment of police and the payment of their salaries and compensation; but that view of the relations of the city to public education, if entertained, is an obvious mistake. The city can not rent, build or buy a schoolhouse; it can not employ or discharge a teacher, and has no power to contract with teachers with respect to their compensation. There is no contract or official relation, express or implied, between the teachers and the city. All this results from the settled policy of the State from an early date to divorce the business of public education from all other municipal interests or business, and to take charge of it as a peculiar and separate function through agents of its own selection, and immediately subject and responsive to its own control. To this end it is enacted in the general laws of the State that all school trustees and boards of education shall be corporations with corporate powers, which, of course, includes the power to sue and be sued in all matters relating to the control and management of the schools." (Gunnison v. Board of Education, 176 N. Y. 11).
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> "If only elected or appointed in accordance with the mandates of the law to perform a duty which is neither local or corporate, and if they are independent of the corporation in the tenure of their office, and the mode of discharging its duties, they are not servants or agents of the corporation, but public or State officers, with such powers and duties as the statute prescribes, and no action lies against the corporation for their acts or negligence." (Ham v. Mayor, 70 N. Y. 459).
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> "He is an employee of the board of education. It is not a part of the corporation of the city of Brooklyn, but is itself a local school corporation, like every board of school district trustees throughout the State (general corporation law, sec. 3), and is like every such board an integral part of the general school system of the State. It is a State and not a city agency, doing State and not city work and functions. Education is not city, village, county or town business. It is a matter belonging to the State government. From the comprehensive foundation by chapter 75 of the Laws of 1795, down to the recent codification of our school laws ('Consolidated School Law,' Laws of 1894, ch. 556), our State system of education has remained a consistent whole." (Ridenour v. Board of Education, 15 Misc. 418).

> "Where the duties which are imposed upon municipalities are of the latter class, they are generally to be performed by officers who, though deriving their appointment from the corporation itself, through the nomination of some of its executive agents, by a power devolved thereon as a convenient mode of exercising a function of government, are yet the officers, and hence the servants, of the public at large. They have powers and perform duties for the benefit of all the citizens, and are not under the control of the municipality which has no benefit in its corporate capacity from the performance thereof. They are not then the agents or servants of the municipal corporation, but are public officers, agents or servants of the public at large, and the corporation is not responsible for their acts or omissions, nor for the acts or omissions of the subordinates by them appointed. And where a municipal corporation elects or appoints an officer, in obedience to an act of the Legislature, to perform a public service, in which the corporation has no private interest and from which it derives no special benefit or advantage in its corporate capacity, such officer can not be regarded as a servant or agent of the municipality, for whose negligence or want of skill it can be held liable. It has appointed or elected him, in pursuance of a duty laid upon it by law, for the general welfare of the inhabitants or of the community. He is the person selected by it as the authority empowered by law to make selections; but when selected and its power exhausted he is not its agent, he is the agent of the public for whom and for whose purposes he was selected." (Maxmillian v. Mayor, 62 N. Y. 164).

> "Essentially and intrinsically the schools in which are educated and trained the children who are to become the rulers of this commonwealth are matters of State, and not of local jurisdiction. In such matters, the State is a unit, and the Legislature the source of power. The authority over schools and school affairs is not necessarily a distributive one to be exercised by local instrumentalities; but, on the contrary, it is a central power residing in the Legislature of the State." (Clark v. Haworth, 122 Ind. 465).

> "The only function of these trustees is the management of the school and they are officers of the school rather than of the county." (State v. Freeman, 61 Kan. 90).

> "The word *system* as used in the constitution means an organized plan, an institution, something established for the use and benefit of the people so long as the want of public education will continue." (Peay v. Talbot & Bros., 39 Tex. 346).

The following cases are also cited as having a very direct and vital bearing upon the proposition:

In 1876 James N. Gerard, inspector of schools in the city of New York, was elected to the State senate. His seat in that body was contested by his opponent, William Laimbeer, upon the ground that the constitution provided that a municipal officer shall not be eligible to election to the legislature. The committee on judiciary reported adversely to the claim of the petitioner and on its recommendation the senate adopted the following preamble and resolution:

> "*Whereas*, In the judgment of the Senate, an inspector of common schools in the city of New York is not an officer under the city government within the meaning of the eighth section of the third article of the constitution of this State; therefore, *Resolved*, That the prayer of the petitioner be denied." (N. Y. Senate Journal, 1876, page 209).

In 1881 the late State commissioner of education, Dr. Andrew S. Draper, was a member of the board of education of the city of Albany. He was elected to the assembly. His seat was also contested upon the same ground that the seat of Senator Gerard was contested. The report of the committee on contested seats, which was an exhaustive treatment of the question and to the effect that a member of a board of education was not a municipal officer, was unanimously adopted. (Assembly Journal, 1881, Volume I, pages 716–727).

It is not contended, not even suggested, that the State control and direction of education which is urged in this article means a State monopoly of educational affairs. Such a scheme of education would be repugnant to the whole American idea of education. State *direction* and *control* of public education means simply that the State shall clearly assert its duty and obligation to the people and shall guarantee to them full protection in their rights and needs in a matter so vital to their happiness and prosperity. It has been a wise procedure on the part of the States to establish in their State school organizations a local school autonomy. Such action gives to a community the right to provide school facilities which shall not only satisfy the standard prescribed by the State, but to provide even higher standards if the wealth, the commercial needs and prosperity, the social and intellectual attainments, and the sentiment of their people will support them.

The administration of public education on the basis of the State instead of the nation has resulted in great inequality of educational facilities in the various States of the Union. Some States, because of their wealth and population, are able to provide for the children of such States school facilities which cannot be provided by the sparsely settled and less wealthy States. It is unnecessary to enumerate all of these inequalities, but some are indicated. The school term ranges in the several States from 108 days per year to 194 days per year. In 11 States the period of the school term is less than 140 days. The average number of days which each child attends school ranges from 55 in one State to 134 in another. In 20 of the States the average number of days in the school term is 90 or less, and in 30 of the States it does not exceed 100 days. The expense per capita of the average day's attendance in North Carolina is $12.31, while it is $86.36 in Montana. The minimum period of compulsory attendance ranges from four months in one State to the full school year in 30 States. It may be said, however, that in several States having a compulsory attendance law, such law is not enforced. It should be further noted that it has taken one-half a century of hard work to write into the statutes the compulsory attendance laws of the several States.

The difference in the qualifications of teachers provided for the schools of the several States also results in an inequality of educational opportunity for the children residing in such States. It is known that in some States young people 16 years of age, and even under such age, are employed as teachers. In 19 of the States there is no minimum age requirement for teachers employed in the public schools. In a majority of the States large numbers of teachers are employed whose education has been obtained solely in the elementary school. In many States the authority to teach is determined entirely by an examination based on preliminary subjects only.

In 26 States the salary paid the chief executive or supervisory school officer is not above $3,000 and runs as low as $1,800. In one of the States the State superintendent of public instruction is chosen at the general election, having been nominated at a direct primary, for a period of two years. He receives a salary of $2,500. His duties are defined in the law as follows:

> "To have general supervision of the public schools; keep official records, etc., at his office in the State capitol; furnish to county examiners questions for the examination of teachers; furnish blanks, registers, etc., to county examiners for use of school officers; prepare and furnish poll books for use at school elections; aid commissioners of the school fund in the administration of the same; make annual report to the governor as to the condition of the schools and the school fund, which report shall be transmitted to the legislature;

> apportion annually to counties the State school funds on the basis of number of persons between 6 and 21 years old; have school laws published and distribute the same; give opinions as to construction of school laws."

This official is a fiscal school officer under the duties imposed upon him by law and not a leader directing and stimulating the educational affairs of his State.

A constitutional mandate requiring the maintenance of free schools throughout a State must be interpreted to mean that so far as possible the system of common schools established throughout the State shall provide *equal* educational opportunities for all the children of the State. It does not mean that a State school system may be established which must of necessity, by its very form of organization, give to the children of one section of the State or of any community in the State educational facilities which are denied the children of another section or of another community. It must also be held that, under this provision of the constitution, a State school system must be established which imposes equal burdens upon the taxpayers who support such system. Inequality of taxation for school purposes is unequality of educational opportunity. A school system, therefore, whose administration imposes an inequality of taxation and which does not provide equal educational opportunities does not conform to the letter or the spirit of the constitution and should be modified.

In many States funds have been established, the revenue of which is used for the support and maintenance of schools. In nearly all States provision is made by which funds are appropriated from the State treasury for the support and maintenance of schools, and apportioned by the chief school officer of the State to the various districts or cities in the State. In some States, as in California, New York, Pennsylvania, New Jersey, Minnesota and Washington, large appropriations are made by the State for the support of the schools. The balance which is needed in any district or city to meet the expense of the maintenance of schools, after applying State funds, is raised by local taxation. Nearly all the States maintain State normal schools for the training of teachers for the public school system, and not only construct the buildings at State expense but meet all the expenses of maintenance and operation.

There is a tendency in legislation on educational matters to follow the general policy of the whole country in legislation upon other important subjects, and to establish in a greater degree State uniformity, direction and supervision in educational matters. In several States provision has been made for minimum salaries of teachers, for the uniform certification of teachers, for the retirement of teachers, for the supervision of schools, for compulsory attendance, for medical inspection and health instruction of pupils, and for the construction of sanitary and safe school buildings.

In some States the administration of public education is highly centralized under the direction of the chief educational officer of the State. This is notably true in the State of New York. In such State the commissioner of education prescribes the conditions on which students may enter State normal schools; he prescribes the courses of study in the State normal schools; he has the final approval of teachers appointed in such institutions and he appoints the members of the local boards in charge of the administration of such schools. The examination and certification of teachers is in accordance with rules and regulations which he prescribes; he is authorized by law to prescribe, by regulation, the functions of district superintendents who supervise rural schools; he may also, by regulation, impose upon city superintendents and boards of education throughout the State duties in the administration of the schools; he may condemn schoolhouses in any part of the State and require new buildings to be erected; he has judicial authority in determining all school controversies arising throughout the State, and his decisions in such matters are final and not subject to review by the courts. The tendency throughout the country is strongly toward greater centralization. This is due to the fact that education is more and more recognized as a matter to which the State must give more careful direction and supervision. A law which is State-wide can be made stronger and more effective than a local law. A general statute is respected more by the public, and is, therefore, more readily enforced, than a local statute.

There are three distinct systems of local administration of schools in operation in this country. These are known as the district system, the township system and the county system. The district system is the one which was first established. When it was first necessary to organize schools a few families living in the same neighborhood associated themselves together, employed a teacher and maintained a school. When school systems were organized in States which had adopted this system, the organization already established was utilized and in some of the States, as in New York, that system is still in operation. In each town throughout a State in which this system is in operation there are several separate school districts. Each of these districts maintains an independent organization with its own local officers, and each is a tax district; so that in each township there are all the way from 8 to 35 separate and independent authorities in charge of the schools of a single town, and possessing the power to assess taxes upon the property of such districts for the maintenance of schools. This kind of an organization for the administration of rural schools has been demonstrated to be cumbersome, obsolete and inefficient. This system has been discontinued in many States and must be in all States before rural schools can be improved and modernized and enabled to serve the people of the agricultural sections as the schools should and as present conditions demand.

In New England and many of the western States, the township is the unit of administration. Under such systems a town board of education is usually chosen at a town school meeting and is given general authority over the supervision and administration of all the schools of a town. In other words, it is the substitution, in rural communities, of an economical and professional system in the administration of schools for the inefficient and unbusinesslike plan which is followed in school districts generally where the school district system is in operation. It gives all the schools of a town the same businesslike management which is generally afforded in cities where all the schools are under the control and supervision of one board of education. In most of the western States the general form of government followed in administering public affairs has been followed in the administration of school matters. In these States, the county is the unit of school administration. Where this system prevails, there is a county board of education and a county superintendent of schools. These officers perform the functions which are generally performed in towns and districts by the town and district boards.

The local school officers, whether under the district, town, or county system, have the direct charge of the administration and operation of the schools. These officers employ the teachers, determine the period of time school must be maintained beyond the period required by law, determine the salary to be paid in advance of that required by statute, make repairs to buildings, construct new buildings, purchase supplies and equipment, and perform such other functions as may be required to operate the schools or to make effective a State plan of education.

A sound, effective, equitable State system of education must rest upon a legal foundation similar to the following:

1. There should be a constitutional mandate which requires the legislature to provide for a free system of common schools. This constitutional provision should require school officers for every unit of school administration in the State, with powers not conditioned in any way whatever upon the action of municipal officers. It should also provide for raising such funds as are necessary for the operation of the schools. In other words the absolute management and control of the schools, independent of all local municipal authority, should be guaranteed the school authorities by the constitution. It should further require the establishment of a State department of education with sufficient authority to administer a sound, progressive educational policy.

2. The legislature should confer on the chief educational officer of the State sufficient power and provide him with sufficient funds to be a real leader of power and influence in directing and supervising the educational activities of the State.

3. A unit of school administration and taxation for the rural communities should be established, embracing not less than the territory of the town, so that rural school facilities may be provided which shall be equal, so far as may be possible, to the facilities provided in the cities and other populous centres.

4. State aid in much larger proportion than has yet been provided should be furnished and distributed upon a basis which shall enable the community having less property values to maintain schools which shall give the children in these less favored sections advantages as nearly equal as may be possible to those advantages afforded children whose homes are in more favored centres.

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STATE TAXATION. See TAXATION.

STATE UNIVERSITIES, The. General Statement.— The history of education hardly offers a parallel to the rise and growth of State-supported institutions for higher learning in the United States during the latter part of the 19th and the first decade of the 20th century. In 1875 20 such institutions had been founded but a very few had risen to any kind of educational prominence. They had at that time a total registration of 2,340 students. In 1885 26 institutions enrolled 4,599 students. In 1903 36 institutions enrolled 41,369 students. On 30 June 1917, according to the latest available figures issued by the United States Bureau of Education, there were 90 institutions in the States and Territories of the Republic supported in whole or in part by public funds and offering collegiate or professional courses beyond the range of the secondary school, with faculties numbering 12,368 persons, a total enrolment of 138,838 students and a total annual working income of upward of $60,000,000.

This movement is not only unrivaled in the history of education; it is also perhaps the most significant and promising development in the history of our democracy. The sentiment which supports the movement is practically universal and it is the product of the spirit of the pioneers of the Central and Western States. Thirty-nine States now tax themselves without stint to provide a practically free education for their sons *and for their daughters* from the kindergarten through the college, and in many instances through the professional school as well. The nine States which do not have regularly designated State-supported universities, nevertheless contribute very generously to the support of higher education and maintain or help to maintain institutions which serve in part at least to perform the functions so admirably performed by such typical State universities as those in Michigan, Minnesota, Wisconsin and Illinois. The nine States which do not have State universities, as the term is now commonly understood, are Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania and Rhode Island.

No people have ever before carried forward such a movement on any similar scale. In the early days Massachusetts and Connecticut and New York and New Jersey gave substantial aid to Harvard and Yale and Columbia and Princeton, but without any idea of becoming responsible for their permanent support and management. The common thought as to the functions of government touching education would not permit more than State aid and encouragement to a university in the colonial days or even in the earlier years of the Republic. The settlement of the great West opened the way for a new educational order of things. The pioneers built for the future, and they were especially anxious that ample provision should be made by the State for the education of their children.

Nearly all the State universities are open to women on an equal footing with men, and the tuition in collegiate courses is free or only a nominal sum. The tuition in the professional schools is ordinarily higher but is not based upon the theory of an adequate financial return for the expense involved. Indeed, the State universities more than any other agency have been responsible for removing professional schools in recent years from the realm of commercial enterprises. This is particularly and fortunately true of the profession of medicine. The State universities in common with a few highly endowed and thoroughly reputable private institutions have demonstrated that the teaching of medicine, as it ought to be taught, is not and cannot be a profit-making business.

All classes are represented in the great student bodies of the typical State universities, but the middle class predominates overwhelmingly. There are many students who find it necessary to “work their way,” and if they do it and sustain themselves in their university work they uniformly gain the respect they deserve for it. Young men and young women work side by side in classrooms and laboratories; they attend social gatherings in company, with little in the way of regulation which is not self-imposed, and with the very best results. Life is free and genuine and natural and earnest, and the sentiment of the campus is wholesome. More than that the spirit of the typical State university is widely regarded as the most splendid promise of our democracy.

Historical Development.— As has been indicated, although all the colleges established in early or colonial days were private corporations they were in nearly every instance the willing recipients of public bequests. This investment of public funds naturally carried with it the thought of State control, but the early colleges were all, more or less, under denominational supervision and did not satisfy the demands of the people as a whole. The growing spirit of democracy is responsible for the birth of the State university. Strangely enough as it may now seem because of the marvelous progress of public education, elementary, secondary and higher, in the North and West in recent decades, the South took the lead in this early movement for publicly supported institutions for higher learning. The constitution of North Carolina framed in 1776 provided that “all useful learning shall be promoted and encouraged in one or more universities.” An institution was founded upon the provision of this clause in 1789 and came into the full control of the State in 1821. But the fullest development of the State university was to be reached in the newer States in the Middle West. The constitution of Indiana, which is typical, provided in 1819 that “It shall be the duty of the General Assembly as soon as circumstances will permit to provide by law for a general system of education ascending in regular gradation from township schools to State university, wherein tuition shall be gratis and equally open to all.”

Impetus was given to the establishment of State universities in 1862 by the passage of the Morrill Act by Congress. This act granted to each State 30,000 acres of public land for each senator and representative in Congress to which the State was entitled under the census of 1860. All money derived from the sale of these lands was to be invested by the State in securities bearing interest at not less than 5 per cent, except that the legislature of the State might authorize the use of not more than 10 per cent of the capital for the purchase of sites for a college or experimental farms. The interest was to be used for the endowment, support and maintenance of at least one college where the leading object should be to teach such branches of learning as are related to agriculture and the mechanic arts in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. Of the colleges benefiting under the act Kentucky, Mississippi, South Carolina and Virginia divide the income between an institution for whites and one for colored students. With the exception of Massachusetts which divides the fund between two colleges, each of the other States maintains one college or university to receive the benefit of the fund. Nineteen States have created and maintain independent colleges of agriculture and the mechanic arts while also maintaining State universities. In each of 21 States the college of agriculture is a part of the State university. Twenty-eight States were allotted 8,160,000 acres of land in scrip; 20 States received 2,890,000 acres in place. The scrip and lands have been sold for $12,643,309.43. Each State now applies all the income for the support of the agricultural and mechanical college. The total income for 1913–14 was $856,318.95. Among the State universities owing their origin to the Morrill Act are those of California, Illinois, Maine, Minnesota, Nebraska, Nevada, Ohio, West Virginia and Wyoming.

The State universities now existing in 39 different States were founded as shown in following table:

Alabama	1831	Nebraska	1879
Arizona	1891	Nevada	1886
Arkansas	1872	New Mexico	1891
California	1868	North Carolina	1789
Colorado	1877	North Dakota	1883
Florida	1884	Ohio	1870
Georgia	1785	Oklahoma	1892
Idaho	1889	Oregon	1876
Illinois	1868	South Carolina	1801
Indiana	1820	South Dakota	1882
Iowa	1847	Tennessee	1794
Kansas	1864	Texas	1883
Kentucky	1878	Utah	1850
Louisiana	1860	Vermont	1791
Maine	1867	Virginia	1825
Michigan	1837	Washington	1861
Minnesota	1868	West Virginia	1867
Mississippi	1848	Wisconsin	1848
Missouri	1840	Wyoming	1886
Montana	1895		

Resources and Revenues.— While the Morrill Act had much to do with the inception of State universities, as has been indicated, the income from the fund and from supplementary acts is a very small part of the amount now expended annually by the several States for the furtherance of higher education. The principal sources of income in addition to Federal land grants are student fees, gifts and State appropriations. As has been noted, fees are merely nominal in all under-graduate courses and are not calculated upon a commercial basis in the professional schools. While the State universities have never strongly relied upon gifts many have profited by donations at various times. This is notably true of Georgia, Indiana, Kansas, Michigan, Minnesota and North Carolina. The University of Virginia received a gift of $2,000,000 in 1909 from Andrew Carnegie and others. The University of Wisconsin and the University of California have each been greatly enriched by private gifts. The chief source of income, however, is from direct appropriations by the legislature. Several States now have a mill-tax for the university which makes assured provision for maintenance. Colorado, Illinois, Indiana, Kentucky, Michigan, Minnesota, Nebraska, Nevada, Ohio, Oregon, Utah, Washington, Wisconsin and Wyoming have a mill-tax rate. For the year ending 30 June 1917 the University of Illinois received $2,111,629 from her mill-tax, the University of Michigan $1,175,385 and the University of Wisconsin $1,285,048.

Organization and Administration.— The supervision and control of the typical State university is vested in a board of regents or trustees usually appointed by the governor with the consent of the senate. In a few instances the regents or trustees are chosen by the people at a general State election. This is true in Illinois and Nebraska. There have been a few conspicuous departures from the general rule, but in the main these boards have been singularly free from political interference and have as a natural consequence drawn to their membership representative citizens generally interested in the promotion of sound education and been able to act disinterestedly upon all important questions coming before them. In Indiana University the alumni have a voice in the selection of the trustees, and the influence of the alumni is coming to be felt indirectly in the selection of governing boards throughout the country. It is not unusual to find one or more graduates on the board of an institution and the tendency in that direction is growing.

In practice the theory that boards legislate and individuals act or execute is the guiding principle in determining the relations of the governing board and the president. This principle of procedure has not been established without a struggle and regents or trustees without conception of their duties and with an inordinate desire to «run» their institutions have more than once caused serious trouble. The typical management of a State university today is not unlike that of the average bank where the board of directors act in an advisory capacity only and leave the management of the daily business of the bank entirely in the hands of the executive officers. Accordingly the position of president of a great State university is a dignified one and calls for well-trained executive powers as well as for seasoned scholarship. Almost universally the president is in fact as well as in name the real executive head of his institution, turning to his board for advice or for endorsement of general plans. In the matter of appointments and resignations upon the faculty the president initiates action and goes to his legislative board only for the confirmation or veto of his recommendations. Men like Angell at Michigan, Northrop at Minnesota and Draper at Illinois, through the free exercise of their great executive powers and by the force of their characters had much to do in determining methods of university procedure which have now widely become unwritten laws and which have in many instances, indeed, been written into university statutes.

While the president is given large executive powers, the very widest latitude in the interior management of the State university is given to the deans and the faculties of the several colleges and the relations of administrative officers and instructors are notably harmonious. The organization of the typical State university may be understood by noting the actual conditions at the University of Illinois. The board of trustees consists of 12 members, three of whom, the governor, the president of the State board of agriculture and the State superintendent of public instruction, are ex-officio members. The nine other members are elected by the people and serve for terms of six years each, three being elected every second year. The board appoints the president who is the general executive officer. The chief administrative officers below the president are the vice-president, the deans of the colleges, the registrar, the comptroller, the dean of men, the dean of women, the adviser to foreign students, the high-school visitor, the executive secretary, the director of the information office, the supervising architect, the university health officer, the director of physical training for men, the director of physical training for women, the professor and commandant in charge of military training, the university librarian and the curators of museums. The university is divided into the following colleges and schools: the College of Liberal Arts and Sciences; the College of Commerce and Business Administration, the College of Engineering, the College of Agriculture, the College of Law, the Graduate School, the Library School, the School of Music, the School of Education, the School of Railway Engineering and Administration, the One-Year Medical College, the Summer Session, the College of Medicine, the College of Dentistry and the School of Pharmacy.

It will be noted that the typical State university practically undertakes with the exception of theology to carry out the maxim of the famous founder of Cornell University, «I would found an institution where any person can find instruction in any study.» The ideals of the State universities as a group were clearly defined by the National Association of State Universities in a report of its committee on standards, adopted in 1908:

> " We may define a standard American university to be an institution: (1) which requires for admission the completion of the curriculum of a standard American high school with a four years' course . . .; (2) which offers in the college of literature and science two years of general or liberal work, completing or supplementing the work of the high school; (3) which offers a further course of two years, so arranged that the student may begin work of university character leading to the bachelor's degree at the end and reaching forward to the continuation of this work in the graduate school or the professional school; (4) which offers professional courses based upon the completion of two years of collegiate work, in law or medicine or engineering; (5) which offers in the graduate school an adequate course leading to the degree of doctor of philosophy. . . .
>
> " To be a standard university an institution shall be equipped to give instruction leading to the degree of doctor of philosophy in at least five departments, according to the standards prescribed in this report and shall have at least one university professional or technical school (which shall require) . . . the two years' collegiate training for admission."

Range of Instruction.— The permanent contributions of State universities to the cause of higher education is abundantly assured because the common sentiment of the people who support them encourages the universities to enter practically every field of scientific research and intellectual activity. Ancient and modern languages and literatures, rhetoric and oratory, history and philosophy, economics and sociology and ethics, education and psychology, music and painting, mathematics, the earth and air and water and sky and life sciences, medicine and pharmacy and dentistry and law, every phase of agriculture and horticulture, the raising of wheat and corn as well as of horses and sheep, dairying and homemaking, architecture, civil engineering, electrical engineering, mechanical engineering, municipal and sanitary engineering, railway engineering, mining engineering, library science, business administration, physical training, and every other interest which stirs the intellect and challenges thorough study are grouped in separate colleges, schools or departments, with the necessary libraries and laboratories and farms and shops for the most practical and effective work. Military training under the immediate charge of United States army officers has long been a feature of the practical and productive work of the State universities. The drill and the study of military tactics usually continue for the first two years of the course. The students, or cadets as they are sometimes designated, wear uniforms, drill with army rifles, engage in sham battles and other manœuvres, and are ordinarily led in dress parade by their own military band. This military training has long been regarded of great value to the physical well-being of the men and has been proved to be immensely worth while to the nation. The officers and men who had their initial military training in university battalions gave a good account of themselves in the war with Spain and the gallant and intelligent service of the many thousands who joined the colors in the Great War with Germany testified to the wisdom of the practice and gives assurance that even larger attention will be given to such training in the future. On the whole it can be said that the students welcome the drills and the accompanying taste of military discipline and it is certain that they are universally glad of the experience as they look back upon it. The State universities have a unique opportunity to lead the nation in a permanent program for adequate preparedness in the future.

Place in the Educational System.— The State universities in many instances, and especially in the Middle West, are a deliberately planned and component part of the educational system of their States. The educational system in a State which emphasizes such a plan may be said to cover 16 years, eight in the elementary school, four in the high school and four in the college. The articulation of the different parts is complete. The grammar-school graduate passes into the high school without examination and the graduate of the approved high school enters his State university without examination. The State university in such an instance is the natural capstone of the State s educational system. The relation of the State universities very generally to the schools below, and especially to the high schools, is intimate and helpful. The relation has its personal and human side due to the intelligent and tactful activity of university high-school visitors whose business it is to visit and inspect high schools for the maintenance of an accredited entrance list. Cordial relations are also further cemented by frequent conferences at the universities of superintendents and principals and teachers upon topics of mutual interest. The high schools are invigorated and inspired by contact with the universities and the universities are kept sane in their entrance requirements by intimate knowledge of the capacity of their prospective students.

Social Life.— The social life at the universities is ordinarily democratic and wholesome. Greek-letter fraternities for men and sororities for women, national in character, have after many vicissitudes proved their right to permanent place in university life. They are now rarely frowned upon and are often encouraged by university faculties. Many of them have permanent homes at the university seat and contribute largely to the comfort and social opportunity of their members. They also are coming to be a means of aiding rather than of hindering university discipline and are frequently employed by tactful college officers in forming and directing student sentiment and action. The relation of men and women students is on the whole helpful to both sexes. The social and college intermingling of men and women is natural, and the disadvantages of a co-educational system, if there are any, are hardly thought of in a great State university. Physical training for men and for women is everywhere emphasized and class and club and fraternity games are very common. Athletics — basketball, football, baseball and track and field sports — occupy the spare time of the students and are valued more by college authorities than the public ordinarily understands as means of creating healthy college spirit and of controlling the enthusiasm of youth. The military band, glee and mandolin clubs, literary and scientific societies also contribute to the enrichment of university life.

Progress and Future.— The older state universities may now be said to have passed the creative or building stage. Their growth and development has been unprecedented, but it has not been without heroic struggle. The people in every commonwealth almost, especially in the Middle West and the Far West, have been united in their desire for a State institution of higher learning, but they have rarely known how best to go about creating and building such an institution. It has remained for educational statesmen — and it has called for statesmanship of the highest order — to lay down the guiding policies and educate the public to a right appreciation of its university. Singularly enough — and yet in a certain sense naturally enough too — the very public which has sought to promote the university has steadfastly insisted that it should prove its worth step by step. Hardly a State university has not gone through the period of being an outcast in the eyes of its own constituents. This means that patience and tact and disinterested public service is woven into the fabric of every one of them. The elementary scope of their progress is now well nigh over. Legislatures need no longer be convinced of their legitimate place and function in the life of the commonwealth, they no longer have to be haled into the open court of public opinion to establish reputable character. They have *arrived* in the minds of the public.

For the last two or three decades much has been heard — sometimes directly from their own press bureaus — about the growth of their appropriations, the size and number and cost of their buildings, the number of their students and in general the "bigness" of their work. This prevailing note has been natural because the material growth of the State universities has of itself changed the educational map of the United States. The enduring service and the progress that is in the long run to count the most is to come through the building of the invisible universities within and without the magnificent walls that have been set up. The bringing together of trained teachers and scholars, the creation of libraries and laboratories and museums that shall do *fine* as well as *large* things, the searching out of new truths, the widening of human knowledge, the leadership of the State in the promotion of health, creature comforts for the masses, sound administration of public affairs — these are the things that are beginning to characterize the State university of to-day and that will undoubtedly signalize its service in the future. There is no better endowment than the will of a great free people for better things and this is the continuing heritage of the State universities.

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STATE UNIVERSITY. See AMERICAN UNIVERSITY AND COLLEGE, THE.

STATEN (stăt'n) **ISLAND,** N. Y., in the southeastern part of the State, is separated from Long Island by The Narrows and New York Bay, from Manhattan Island by New York Bay, from New Jersey by Kill Von Kull, Newark Bay, Arthur Kill and Staten Island Sound. Staten Island was discovered by Henry Hudson in 1609, and its first settlers were Dutch. It is about 14 miles long and five miles wide. The surface is somewhat hilly along the coast; in some parts there are bluffs. The island constituted the county of Richmond and had a county government until 1898, when it became a part of New York City under the name of Borough of Richmond. It is chiefly a residential suburb of the Borough of Manhattan, but in the interior are farm lands, and there is considerable manufacturing. Fort Wadsworth, on the east coast, at the entrance to The Narrows, is one of the most important fortifications in the United States. The improved road system of the island embraces over 200 miles of highways. The police force of New York City has headquarters, detective bureau and four police precincts on Staten Island. The city fire department also affords fire protection to all the larger places on the island. Education is well looked after throughout Staten Island, which has many good private schools, two large high schools, one in Saint George and the other in Tottenville, and 34 public schools. It has, therefore, become one of the favorite residential sections of New York City. The borough is divided into five wards; but the villages which were incorporated before the island became part of New York retain their Federal post-office organizations independent of the New York post office. Some of the largest post offices are at Port Richmond, New Brighton, Stapleton, Tompkinsville, Saint George, Tottenville and Rosebank. During the Revolutionary War Staten Island was occupied by a large body of British soldiers, and their old fortifications form historic landmarks to-day. Pop. about 200,000. Consult Mershon, S. L., ‘The Major and the Queen’ New York 1915); ‘Staten Island Illustrated’ (New York 1911); ‘Staten Island and Staten Islanders’ (New York); ‘Historical Guide of the City of New York’ (New York).

STATEN (stăt'n or stä'tĕn) **ISLAND,** South America, belonging to the archipelago off the southeast coast of Tierra del Fuego, and virtually a continuation of the same, extends for 38 miles from northeast to southwest between Capes Saint John and Saint Bartholomew, and is separated from Argentina by the Strait of Le Maire. It rises in Mount Buckland to a height of 3,000 feet. The peak is covered with snow, the slopes verdant in evergreens, shrubs and plants. There is great humidity or rain at all times, and the temperature is even. The chief harbor, among several excellent ones, is Port Cook, on the northeastern coast. This island was formerly an important whaling station for the English.

STATES, Admission of. No specific form of procedure is provided in the National Constitution for the admission of new States to the Union. Different methods of admission have marked the addition of the 35 States to the original 13. For admission, however, certain conditions must exist. The community must be organized with a population in numbers and character capable of upholding self-government, and Congress is the final judge whether these requirements are in evidence. The decisions of Congress, however, have often been influenced by party reasons, and in 1872 it was enacted that no State should be admitted thereafter unless "having the necessary population to entitle it to at least one representative according to the ratio of representation fixed by this bill." The action of a Congress, however, does not appear to have a binding effect on subsequent Congresses, for in contravention of this act Nevada, Wyoming and Idaho among other States were admitted. To gain admission, a petition is presented to Congress, which grants an enabling act if the request is favorably received. While these acts vary in details, the general principles define the boundaries of the new State, authorize the people to frame a State constitution, fix the mode of its formation and adoption, prescribe rules of suffrage for election purposes, set forth such provisions as Congress requires to be inserted in the document and provide for its submission to Congress or the President for approval. When all the terms of the enabling act have been complied with, Congress by resolution, or the President by proclamation, declares the new State admitted to the Union. Consult Beard, C. A., ‘American Government and Politics’ (1910); Dunning, W. A., ‘Essays on the Civil War and Reconstruction’ (1898); Hart, A. B., ‘Actual Government’ (1908); Poore, B. P., ‘Charters and Constitutions’ (1877); Thorpe, F. N., ‘Federal and State Constitutions’ (1909); Willoughby, W. W., ‘American Constitutional System’ (1904).

STATES, Classification of. States or nations may be classified according to: (a) the extent of the political state; (b) the structure of the political state; (c) the structure of the government. In political science a state is understood to be a body of people inhabiting a given territory, organized for common purposes, independent of external control and supreme in the enactment and enforcement of law within the state territory. For the enactment and for the execution of law, and for international interchange, it is essential that the state be organized for public purposes. Without a definite political organization, no body of people can be recognized as having international status. This organization must be adequate to ascertain and express the public will and must have supreme power to subordinate all other wills to that which is taken as the will of the state. The essential marks of sovereignty are independence without and supremacy within.

States may be democratic, oligarchic, or autocratic. A democratic state is one in which the social state dominates the political. In an oligarchic or aristocratic state the social state relatively is a small part of the political. In an autocratic state political power is supposed to be vested in a single person. As democracies, republics and monarchies, states may be classified as: (a) Pure democracies, in which nearly all functions of government and especially legislation are performed directly by the political state; (2) republics, in which representatives chosen directly or indirectly by the political state carry on nearly all the functions of government, including legislation and adjudication; (c) monarchies, in which the head of the administration owes his position to birth rather than to personal choice by the political state. A state is oligarchic or aristocratic, if the members of a branch of the government owe their position to birth or some other cause independent of the will of the political state, as in the British House of Lords, the upper house or senate of the imperial legislature, where the members hold their position by hereditary title, and some by virtue of holding some other office. But with a few aristocratic survivals, the British Empire constitutes a democratic monarchy, republican in fact, and so are most modern monarchical states, the monarch being really little else than the hereditary president of a more or less democratic republic.

The organization of the political state may also determine its classification. It may be either centralized or federal, if (a) the will is determined in mass, as in France; or (b) if the will of the state is determined by balancing the separate will of a series of fundamental groups, as in the United States, Switzerland and in Germany. The well-being of the social state as a whole is the purpose of all political organization, and a centralized government may be more efficient than a federal government, but where intelligence and education are generally diffused among a people self-reliant and mutually tolerant, a federal government is more responsive to the variety of ideas which may characterize a large state, and is more likely to be permanent. Autocracy may attain high efficiency but is usually attended by tyranny. While a democracy has a republican form of government, a republic is distinguished by an oligarchic tendency, and a monarchy may be democratic or oligarchic, as well as autocratic. The most practical form of state appears to be a republic with powers delegated to the government. With the nominal exception of Canada, all North and South American states have adopted this form, also France, Switzerland, Portugal and China and in 1919 the newly formed European states. Consult Dealey, J. Q., 'Development of the State' (1909); Willoughly, W. W., 'Nature of the State' (1896); Wilson, W., 'The State' (rev. ed., 1909).

STATES OF THE CHURCH. See CHURCH STATES.

STATE'S EVIDENCE is a term applied to evidence in a criminal case, in the form of a confession of one who committed or participated in the commission of a crime, and to be admissible it must be freely and voluntarily made. The equivalent law term in England and throughout the English-speaking British possessions is king's evidence (or queen's evidence). There is no provision in the law to make a state's evidence agreement legal or binding, yet such an agreement is frequently made and adhered to on the part of the State and countenanced by the court, as a means of securing the conviction of other criminals. In case where confession has been obtained under promise of immunity from the law, and the witness thus making the confession is subsequently placed on trial, it is a general practice not to use his confession against him. There is a general tendency in the courts of many of the States of the Union not to convict a defendant upon the uncorroborated evidence of an accomplice. See ACCESSORY; ACCOMPLICE; PRINCIPAL.

STATES-GENERAL, the name given in France till 1789 to the general assemblies of the deputies of the three orders of the nation, the clergy, nobility and the third estate (bourgeoisie). When peers were present it was not as forming a separate body but as the representatives of their order. The right of convoking the states, belonged to the king, to the regent, or the lieutenant-general of the kingdom. There was nothing fixed as to the number of electors or deputies, nor as to the conditions entitling one to vote or to be elected. As far back as the time of Charlemagne, and probably earlier, clergy and nobles assembled twice a year to deliberate on matters of public interest and importance. After about 100 years of active life these assemblies seem to have died, or to have been suspended; and it was not until 1302 that the States-General were first convoked by Philip the Fair to support the quarrel of the king with Pope Boniface VIII. Six years later the States-General, at the instance of the king, condemned the Knights Templars. The States-General had no power of making laws, but they served as a check on the arbitrary power of the sovereigns through their ability to give expression to the will or displeasure of the people. But as the States-General became more exacting of the sovereign, and the latter, through his increasing military power, more and more independent of the popular will, the States-General were less and less frequently called together. In 200 years they assembled only twice at the call of the king, once in 1614, and again in 1789. On this latter date they assumed to themselves the title of National Assembly, and that of States-General was never afterward revived in France. See France — History b.c. 58 to a.d. 1796.

The name of States-General is also given to the legislative assembly of the kingdom of the Netherlands, in which there are also provincial states for local government.

STATES RELATIONS SERVICE. See Agriculture, Department of.

STATES or STATE RIGHTS, in a federal government, the rights of the several States in their constitutional relations to the central or national government. In United States history the term has played a prominent part since the early years of the 19th century, and especially during the period immediately preceding the Civil War, when it represented the prevailing view in the Southern States regarding the relation of those States to the Union. Out of this view developed the doctrine of nullification and the attempts to put it into practice; and the doctrine of secession as put to practical test in the Civil War, the final issue of which made an end of the State-rights view in its former constitutional aspects. See Confederate States of America; Government; Nullification; United States — State Constitutions; Dartmouth College Case.

STATESBORO, Ga., city and county-seat of Bullock County, 42 miles northwest of Savannah, on the Savannah and Statesboro and the Central of Georgia railroads. The First Congressional District Agriculture College is located here. The district is devoted principally to the production of melons and cotton, and there is a cottonseed-oil mill. Pop. 2,529.

STATESVILLE, N. C., city, county-seat of Iredell County, on the Southern Railroad, about 43 miles north of Charlotte and 20 miles northwest of Salisbury. It is in an agricultural and stock-raising region in which there is also considerable corundum mining. Cotton, gain and tobacco are cultivated extensively. The chief manufacturing establishments are cotton and tobacco factories, flour and lumber mills, tanneries, foundries and ironworks. The trade is chiefly in grain and cotton and tobacco products. There are seven churches and public and private schools. Pop. 6,000.

STATHAM, stăt'ạm, **Henry Heathcote,** English architect and musical critic: b. 11 Jan. 1839. He studied architecture in Liverpool and practised there for a time, but removed to London about 1870, and since 1883 has been editor of *The Builder*. He has written much on both archiecture and music, and was for many years musical critic to the *Edinburgh Review*. For several years in succession he gave classical organ recitals on Sunday afternoons at Albert Hall, London. He has published ‹Architecture for General Readers›; ‹Modern Architecture›; ‹Architecture Among the Poets›; ‹My Thoughts on Music and Musicians›; ‹Winged Words›; ‹The Organ and its Place in Musical Art›; ‹Critical History of Architecture›; ‹What is Music› (1913); ‹Form and Design in Music.› In addition he has written much on art, music and literature.

STATICE, stăt'ĭ-sē, a genus of maritime or desert plants of the family *Plumbaginaceæ*, called sea-lavender, marsh rosemary, etc., and found chiefly in the northern hemisphere. They are usually perennials, with tufted, alternate leaves, sometimes becoming diminutive shrubs. The flowers are commonly borne in cymes or panicles, composed of one-sided spikes, and have scarious, membranous, funnel-shaped calyces, colored, but often of a different hue from that of the five long-clawed petals. The fruits are small astricles. Several species are cultivated, among them the Russian statice (*S. latifolia*), notable for its very thick, long, perennial root, which is used for tanning in its native country. It is a handsome border-plant, having a radical tuft of long leathery leaves, elliptical in shape, and very loose panicles of minute blue flowers sometimes measuring a yard across, and useful in bouquet-making on account of the delicate sprays. Certain species yield valuable remedies, and others are useful as fuel in the deserts of Afghanistan.

STATICS. See Mechanics.

STATIONERS' HALL, the name of the hall of the «Master and Keepers or Wardens and Commonalty of the Mystery or Art of the Stationers of the City of London.» The company was incorporated in 1557, and had, till the passing of the Copyright Act in 1842, an absolute monopoly, as all printers were obliged to serve an apprenticeship to a member of the company, and every publication was required to be «Entered at Stationers' Hall.» This registration is no longer compulsory, but the practice of registering is still useful in making good claims of copyright. (See Copyright). Consult Arber, E. A., ‹Transcript of Stationers' Registers, 1554–1640› (Vol. I, London 1875–94).

STATIONS (Latin *statio*, from *stare*, to stand) in the Roman Catholic Church, the name given to the Wednesday and Friday fasts. Tertullian says that the name is derived from military usage. On those days the Christian stood on guard and «watched in prayer.» The word has another peculiar signification in the city of Rome. There certain of the churches are visited on stated days by clergy and people, and those churches are called Stations. But by the word stations are more usually understood the «Stations of the Cross,» a very popular devotional exercise which is in use throughout the Catholic world. These stations are a series of 14 images or pictures ranged round the interior of a church or even along a public way, in which are represented 14 incidents in the life of Jesus on the day of his crucifixion, namely, Sentence of death pronounced by Pilate; Christ receiving the cross; his first fall; his meeting with his mother; the cross borne by Simon of Cyrene; Veronica wiping Christ's face with a handkerchief; his second fall; his words to the women of Jerusalem; his third fall; stripping him of his garments; his crucifixion; his death; taking the body down from the cross; the burial. The people move in procession from station to station, reciting prayers at each, and between stations chanting the Stabat Mater, one stanza at a time. (See Via Dolorosa). Consult

Thurston, H., ‹The Stations of the Cross› (London 1906).

STATISTICAL METHOD, The. The word «statistics» was coined about the middle of the 18th century by Gottfried Achenwall, a professor at the University of Marburg. Achenwall derived the term from the Italian word «statista,» meaning statesman, which, in its turn, came from the Latin «status,» meaning state. E. A. W. Zimmerman, professor of Natural History at Brunswick, in 1787, in a work entitled ‹A Political Survey of the Present State of Europe,› gave this history of the origin of the word and the science which it represents: «It is about 40 years ago that the branch of political knowledge which has for its object the actual and relative power of the several modern states, the power arising from their natural advantages, the industry and civilization of their inhabitants, and the wisdom of their governments has been formed, chiefly by the German writers into a separate science. . . . By the more convenient form it has now received . . . this science, distinguished by the new coined name of «Statistics,» is become a favorite study in Germany.»

At first the method of approach was descriptive, but it was inevitable that figures, because of their greater simplicity and compactness, should take a more and more prominent part in the development of the new science and finally replace the old verbal form of exposition. Next, as a man naturally pictures an object in terms of its most prominent characteristics, it was not long before the term «statistics» was transferred from the science to the compilation of the facts and figures involved and, finally, to the arrays of facts themselves. Thus we read in the first number of the Royal Statistical Society *Journal* issued in 1838–39, « ‹Statistics› may be said, in the words of the prospectus of this society, to be the ascertaining and bringing together of those facts which are calculated to illustrate the condition and prospects of society.» The name, having once come to be applied to the data themselves, it was but a short step to the calling of any compilation of figures or facts, «statistics,» which is the modern usage of the term, while the science itself has come to be called «The Statistical Method.» The latter may be defined briefly as the science of analysis and exposition of quantitative or qualitative data secured through enumeration or experiment.

Application of Statistical Method. (*a*) *Scope.*— From this definition it may be seen that the statistical method is found applied wherever compilation of facts are given and accurate conclusions therefrom are wanted. Perhaps the most common application is that of the governmental census. The most ancient of our literatures, including the Fourth Book of the Bible, the name of which denotes its reference to a statistical subject, abound in references to the taking of censuses in preparation for large undertakings, such as the building of pyramids, military campaigns, the distribution of lands, and the levying of taxes. In modern times the taking of the census has been made periodic — in the United States every 10 years — and has been developed along very extensive lines, not only gathering the data, but analyzing and illustrating them as well. The student of statistics will find in these government reports a wonderful wealth of data on innumerable subjects.

But the Statistical Method is no longer confined to investigations such as the census, by governmental agencies for administrative or other purposes. To-day each large corporation has its statistician, and all policies of the concern are based on his findings. Very frequently a business concern has been changed from a losing venture to a great success by a new manager who installed scientific methods based on a statistical study of the conditions affecting the business. Rents of business locations in cities are determined by a study of the number of people who pass the place. In fact modern industrial development has come to depend more and more on statistical research. In the sciences, both physical and biological, the statistical method is of foremost importance. The chemists who were given the task of finding a suitable clay for spark plugs for the Liberty motor solved the problem by this method. New serums and medical treatments are now subjected to the severest statistical tests before they are accepted by the medical profession. Statistical analyses have enabled the chemist to predict the existence of unknown elements with given atomic weights; and the astronomer to predict eclipses and locate new planets. The whole doctrine of evolution and heredity rests on a statistical basis as shown by investigations of Mr. Francis Galton and Prof. Karl Pearson in the field of the mathematical theory of evolution, and by the work of Gregor Mendel and his followers along the lines of Mendel's Laws of Alternative Inheritance.

In the social sciences, especially in the field of economics, the statistical method is equally indispensable. No economist would attempt to arrive at a conclusion concerning the production or distribution of wealth without an exhaustive study of statistical data. Business men and economists alike are convinced that only when Congress bases its tariff legislation upon a scientific study of the natural resources and economic needs of the various parts of the country will an equitable tariff law be passed. Careful analysis of the effects of the English system of «out-relief,» the granting of partial relief to paupers without sending them to the poorhouse, showed that the system was lowering wages and increasing instead of decreasing pauperism, thus producing a social evil which grew as it fed on itself. In economics and the other social sciences the old Roman proverb is pre-eminently true, «Sine numero nihil demonstrandum est.»

In seeking to apply the statistical method to any line of investigation care must be taken to avoid certain errors likely to be encountered where statistical data are inaccurately compiled or carelessly applied. One of the most common causes of error in conclusions derived from statistical data is the lack of proper definition of the elements entering into the problem concerning which data are being gathered. Other errors arise from careless or premeditated abuse of data, correct in themselves, but leading to erroneous conclusions when improperly used. False statistical deductions may result from inaccuracy, from slovenliness in gathering or arranging data, from partial statement of truth, from a comparison of heterogeneous qualities, or from lapses in logic. The man who thought he had discovered that eminent mathematicians were remarkable for their longevity was correct in his data, but careless in their application. He should have compared the average length of life of eminent mathematicians, not with the average length of life of all human beings including those who die in infancy, but with the average length of life of men who attain intellectual maturity. Again, it is manifestly unfair to judge the skill of the physician by the number of his patients who have died, without also considering the total number he treated. Such abuse of statistics as the use of the same set of figures to prove that prohibition does prohibit, and that it does not prohibit has, to some extent, destroyed the popular faith in statistics and is responsible for the often heard expression, «You can prove anything by figures.» Statistics may be likened to a razor, a delicate and very effective tool when handled by an expert but very dangerous to an infant. While care must be taken that accuracy is preserved in the gathering of statistics too great minutiæ in description defeats the object sought. If, for instance, we wish to study the distribution of wage-earners in industrial establishments we will find ourselves lost unless we effect a grouping into a few classes, as there is a rather small limit to the number of impressions which a mind can receive and hold at one time. Closely related to this error of excessive attention to minutiæ of detail is the attempt at greater accuracy in statistical deductions than the facts themselves warrant. There is in statistics much swallowing of camels and straining at gnats. We are continually confronted with financial statistics carried out to the last cent when many of the individual items cannot be ascertained with any degree of certainty to within the nearest thousand, or even million. The young man who, wishing to know the circumference of a wagon wheel, multiplied the diameter, obtained with a 35-inch yard stick, with the value of π carried out to 18 decimals, is illustrative of our ingrained but untrained desire for accuracy. That no resultant can be more accurate than the least accurate of its constituents is an axiom that is altogether too often forgotten, and much time and labor have been spent in efforts to secure precision not warranted by the facts. On the other hand no statistical conclusions should be adopted without a statement indicating the degree of reliance which may be placed on them. It must be borne in mind that statistics is "the science of large numbers," that results obtained from a few cases cannot be considered representative and should, therefore, be received with due caution. It can readily be proved that the precision of a determination is proportional to the square root of the number of observations, but also that there is a limit beyond which it does not pay to carry the refinement.

b. *Statistical Tables.*— In employing the statistical method statistical tables, both simple and complex are constantly brought into use. To illustrate the construction of these we will use the problem, referred to in a previous paragraph, of the distribution of wage-earners in the United States. The 1910 census (Vol. VIII) divides the industrial establishments of this country into the following seven classes: those employing 1 to 5 wage-earners; 6 to 20; 21 to 50; 51 to 100; 101 to 250; 251 to 1,000; and over 1,000. We construct a table with these seven classes in one column and in a second column enter the number of establishments in each class. For comparative study we now enter in a third column the number of establishments in each of these classes as given in the census of 1900. This suggests a fourth column giving the increase or decrease for each class, and still another column giving the proportions, expressed as percentages, which such increase or decrease bears to the figures given for the earlier of the two years. Such a table is called a simple statistical table. Similarly we may construct another table, but giving here the number of wage-earners in each class. A combination of the two into a double-column table, such as is given in the census of 1910, is called a complex statistical table. Applying to this the proper arithmetical operations gives numerous interesting and important facts.

c. *The Use of the Relative.*— While satistics are absolute facts, a study of them is really a study of relatives. In the above problem this was shown by the introduction of proportions. In that problem the number of establishments employing 1 to 5 wage-earners, or the number of employees, means little unless we also know the proportion which these numbers bear to the total. This proportion is, in general, best expressed as a percentage. In vital statistics, however, it has become customary to use a radix number; so many deaths per thousand, for instance. Except in actuarial mathematics, where the formulæ have been developed on this basis, the latter is not a good method, as it does not readily yield itself to mathematical treatment.

d. *Graphic Methods.*— To show vividly the facts compiled in statistical tables and the conclusions to be deduced therefrom the statistician uses various graphic illustrations. What the microscope is to the biologist and the telescope to the astronomer, of like importance is this mechanical interpretation or illustration of statistics to the statistician. The common housefly is to the casual observer an uninteresting and repulsive creature, but the microscope reveals it as an object of wondrous structure and beauty. Similarly a table giving the temperature, taken each half hour during a certain day, means very little to us, but the curve automatically drawn by a thermograph records the changes in temperature momently and still tells us its whole story at a glance.

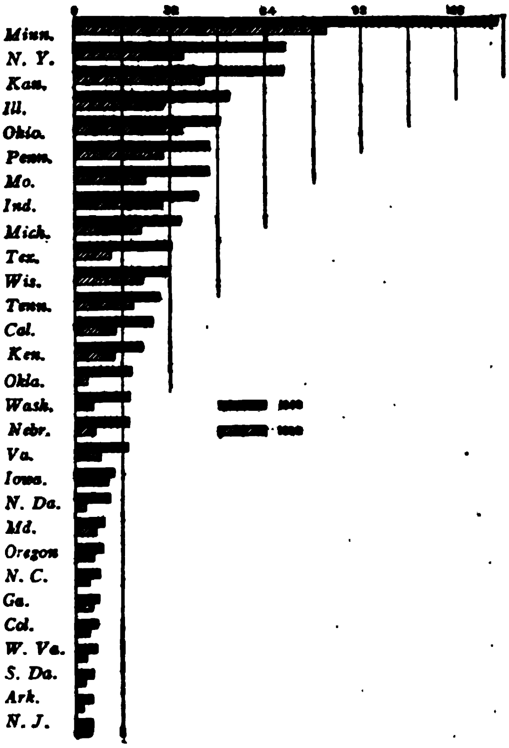
To construct such a frequency curve, as it is called, where variation is reasonably continuous, as in the above problem, erect at equal intervals along a horizontal line a series of vertical lines called ordinates, proportional in length to the number of objects in the classes which they represent. Then join the tops of these ordinates in such a way as to make a smooth curve. Such a curve not only makes clear to us the fluctuations in the frequency of its variates, which in the table are effectively hidden, but it also enables us to make important comparisons. We may, for instance, draw, on the same diagram but in different colors or with different types of lines five curves representing the total gold and silver in the national treasury, and the amount of silver,

silver certificates and treasury notes in circulation at the end of each quarter for a number of years. We have thereby before us the whole financial history of the country during this period and are, furthermore, able to make both interesting and valuable deductions by comparisons of these curves. These curves play an especially important part in the physical and biological sciences as they enable the scientist to replace the rough approximations obtained from a few observations with the law governing the frequency distribution. As aids in interpolation and extrapolation these curves are indispensable. This branch of statistical inquiry has been developed to its present high stage of perfection by Prof. Karl Pearson, who, through his work on the 'Mathematical Theory of Evolution,' has breathed into the clay of dry statistical data a living soul.

Where variation is not continuous or where discrete objects are under consideration the histogram or pictogram are preferable. The histogram is merely a succession of rectangles obtained by drawing through the tops of the frequency ordinates lines parallel to the base. A common and effective pictogram is a circle divided into sectors, the areas of the sectors being proportional to the magnitude of the respective objects under comparison. For instance, we can illustrate the relative values of the principal crops of Nebraska by dividing a circle into five sectors of the proper relative sizes and label them "corn," "wheat," "oats," "hay," and "all other crops." Or we can place, side by side, on equal bases, five rectangles whose altitudes are proportional to the values of these crops. A complex table can be illustrated by superimposing two such diagrams on each other, as shown in the preceding figure. The number of ways in which such illustrations can be made is limited only by the limits of human ingenuity.

FLOUR MILLS AND GRIST MILLS.— VALUE OF PRODUCTS FOR LEADING STATES, 1909 AND 1899.

(Millons of dollars.)



This pictogram shows us at a glance, and in a clear and striking manner, a number of important facts, as for instance: the actual values of the milling products of the more important milling states in 1899 and again in 1909, the growth of the industry in each state during this period, the relative importance of these states in 1899, and again, ten years later, which states have made the greatest progress, and which have been practically stationary.

e. The Use of the Average.— Because of the important part which they play in statistics, the statistical method has been defined by some writers as "the Science of Averages." Averages may be considered as types through which we get an adequate conception of groups of variates and by means of which comparisons with other groups may be effected. Thus, though men of any race may differ greatly in height, we still get a very fair conception of the relative stature of a Patagonian Indian,* an Englishman, and a Lapp when we learn that their average heights are six feet one inch, five feet seven inches, and five feet, respectively. The first real development of scientific methods in statistical study came about through the needs of astronomers for some means of securing accurate determinations from their ever growing stock of observational data. It was found errors of observation were symmetrically grouped about their arithmetic mean, where they were clustered most closely, and decreasing continuously and equally in number in accordance with a certain law, called the normal law of errors, as the observation receded in either direction from the mean.† This law, also known as the Law of Probability or the Law of Chance, was found by the great Belgian astronomer and mathmatician, Jaques Quetelet, to govern not merely the distribution of errors of measurement of inanimate things, or direct the action of "blind chance," such as the manner in which coins, when tossed, turn up "heads" or "tails," but also the chance distributions in the animate world. Whether dealing with barometric pressure, human height or the size of plants the law was found to hold. Later it was found that where a bias exists, as, for instance, the inclination of the loaded coin to turn up one face more frequently than the other, or wages to taper off more rapidly to the lower limit, the law still held, but in a generalized form. The place of concentration which is no longer the mean has been called by Professor Pearson the "mode."

There are three forms of averages in common use, two of which have already been referred to. The three are the arithmetic mean, the median and the mode, the first being by far the most widely used. To these may be added the geometric and harmonic means, which, though seldom used, are indispensable in certain lines of investigation. The nature of the mode has already been described in the preceding paragraph. The median, meaning the halfway point, is especially useful in dealing with non-measurable quantities, such as economic unrest, eye color or mental characteristics. We cannot for instance, state in figures the mental alertness of a class of boys, but we can readily arrange them in the order of their intelligence and thus determine the average boy. In a normal distribution the mean, the median and the mode naturally coincide. The arithmetic mean may be subdivided into the simple and the weighted. The simple arithmetic mean of two or more quantities is the sum of those divided by their number, without regard to their respective weights or relative importance. The weighted mean is the sum of the quantities, each multiplied by its weight, divided by the sum of the weights. The difference can best be pointed out by some examples. If we wish to find the average wage in an industry we cannot do this by simply averaging the scales of wages paid in the various occupations. If that were done the few, highly-paid experts and superintendents would count as much as the many common laborers and so give a very misleading conception as to the wages really paid. The true average is obtained by weighting each wage by the number of men receiving that wage, adding the products and dividing by the number of men. In this case the weights are definitely determinable numbers, which is not always the case. An astronomer taking a series of observations on a certain evening will average these as equally good. When, however, he wishes to combine observations taken on different evenings he may consider these sets as of unequal value because of the unequal atmospheric conditions under which the observations were made. He will then use as weights numbers which, in his estimation, give the relative values of the observations.

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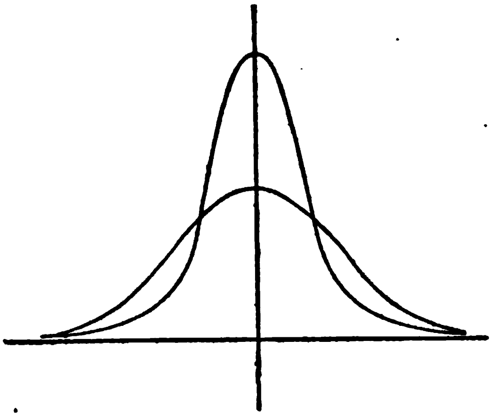
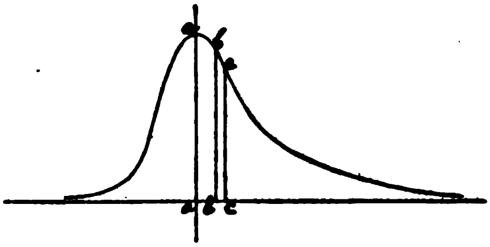
* Consult Pearson, 'Reconstruction of the Stature of Prehistoric Races' in Transaction Royal Phil. Soc. (1898).

† Given by the equation $y = \frac{1}{\sqrt{2\tau c}} e - \frac{(X-a)^2}{2c^2}$ where y is the frequency of the deviation x from the mean a, c is a mathematical consent called the standard deviation, and e is the base of the natural system of logarithms.



Normal probability curves illustrating the different degrees of skill of two marksmen, as indicated by the concentration of the hits about their centre of gravity in the one case and by their scattering in the other.



Moderately asymmetrical skew curve; ages of wives for given age of husband at marriage. *aa* mode; *bb* median; *cc* mean. The age of the bridegroom in this case is between 24 and 25 years, and the total number of marriages is 28,454. The mean age of the bride is 22.19 years while the modal age is 20.42 years. The age of the bride rises very rapidly from 15 — 16 years up to about 20 years, after which it tapers off rather slowly, the maximum age being 45 years.

An excellent example of the use of weights is afforded by the index numbers for the changes in wages or prices of commodities. In comparing prices of different years we find that, though some have increased and others have decreased, there has been a general tendency in one direction. To measure this tendency, that is, to determine the increase or decrease in the purchasing power of money, is one of the most important tasks of the economist. It is at once obvious that we cannot solve the problem by taking the simple arithmetic mean of the prices of all commodities, for that would unduly accentuate the lesser things; would, for instance, give matches as great weight as coal. Instead, we take the most important ones whose prices we can estimate rather accurately and tabulate for a number of years. Taking any year as a base year we can then express the prices of each other year as percentages of those of the base year. The properly weighted mean of these percentages will then measure the movement of prices during this interval.

In the use of the mean as a type it must be remembered that it will not fairly represent the group if there is too great a divergence from it within the group. For instance, statistics may show the same per capita wealth, say $1,000, in two cities without giving us any idea as to the real prosperity of the inhabitants. The one city may have the wealth well distributed with all of its inhabitants prosperous and happy, while the other has its slums and its palaces with only a small middle class. If, however, to this per capita average is appended another figure showing limits within which half the people come, we can form a better estimate of the economic condition of the city. Suppose in the one case we find that this limit is $100 in excess or defect of the mean while in the other it is $400. We would then give the per capita wealth of the two cities as $1,000 ± $100 and $1,000 ± $400, respectively. In the one case one-half the people fall within the narrow class of more than $900 and less than $1,100; in the other the limits would be $600 and $1,400. This additive quantity is called the probable error or probable deviation. We are, accordingly, in the development of the statistical method, interested not merely in the average as a type, but also in the divergence of the group from the type. The best measure of an average deviation from the mean is the so-called standard deviation, the square root of the mean of the squares of the deviations. Before we can compare the variabilities of two groups we must first reduce their measures of dispersion to relatives by expressing them as percentages of the means. For instance, a difference of 1,000 pounds between the weights of two elephants is less, proportionately, than a difference of one ounce between the weights of two mice. Failure to recognize this principle has led some very eminent biologists into espousing theories absolutely at variance with the facts. But the statistician does not limit his study to the consideration of a single variable. One of his most important tasks is to analyze the relationship between one variable or phenomenon and another. He seeks, for instance, to find the correlation between poverty and crime, between the heights of fathers and of their sons, between the ages of husbands and of their wives, between the price of wheat and the marriage rate, between the size of the wheat kernel and its protein content, between vaccination and immunity from disease. We cannot, however, directly and definitely measure the effect of one variable on another because of the many other variables which enter into the problem. But by dealing with a large number of observations we can, to a large extent, neutralize these disturbing causes, and so make it possible to secure a very fair determination of the correlation between the two variables under consideration. We may, for instance, seek to determine the correlation between rainfall and the potato crop though recognizing that the size of the crop is a function, not merely of the amount of rainfall, but also of the temperature, culture, seed and a multitude of other causes. By dealing with a sufficiently large number of years, however, we can eliminate these disturbing elements and so secure an average value of the correlation sought. For the methods and formulæ used in this computation the reader is directed to Yule's work on the 'Theory of Statistics.'

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STATISTICS is the science that deals with the collection, tabulation, analysis and presentation of numerical data. Any phenomena that may be classified and counted may be studied by the statistical method, in fact, no other method will yield a comprehensive, quantitative view of many kinds of phenomena. Statistics thus becomes the adjunct of all the sciences and the indispensable agency of governments in acquiring information concerning production, trade, distribution of wealth, unemployment, population, births, marriages, deaths, divorces, diseases, accidents and the many other matters on which the welfare of the state depends.

The principal functions of statistics are: 1. To furnish definite bases for comparison of related facts dealing with phenomena of the same or of different periods.

This function is well illustrated by the decennial census taken by the Federal government. Such census gives a comprehensive view of the population in all the various civil divisions of the country and enables comparisons to be made of the composition of the population in the several divisions with respect to age, sex, marital condition, nativity, citizenship, etc. The comparison of the data of the latest census with that of preceding censuses adds greatly to its significance. The facts relative to the increase or decrease of population and the changes in composition that have taken place during the 10-year period are fully as interesting and valuable as the data contained in the census itself.

2. To reveal laws underlying phenomena that could not be determined by individual observers.

In dealing with large numbers, by the statistical method, the constancy and uniformity of natural and social phenomena become apparent. In other words the laws underlying the phenomena are revealed. The mortality tables used by insurance companies constitute a practical illustration.

3. To show trends in phenomena that otherwise would be imperfectly known.

Changes in the trend of rates of birth, death, marriage, divorce, etc., are shown adequately only by statistics.

4. To reveal relations of cause and effect that otherwise would remain hidden.

The discovery by statistics of the relative longevity of total abstainers and moderate drinkers is a noteworthy example.

5. To serve as a guide for legislative, social and commercial action.

Statistics of dependents, delinquents and defectives are a prerequisite to the formulation of adequate statutes relating to these classes. The financial statistics compiled by the government and by commercial agencies are indispensable guides to investors, banking and other business houses and to the government itself.

Methods.— In the compilation of statistics three distinct processes are necessary, namely: 1. Collection of data; 2. Tabulation and charting of data; 3. Analysis and summarization of data. The collection of data comprises two separate steps: the preparation of blank schedules and the filling out of the blanks. The making of the schedule is a very important piece of work as on it depends the success or failure of the statistical undertaking. The principal points to be observed in preparing inquiry blanks are: (a) The schedule must be made to fit in with the general tabulation scheme. The whole study must be very carefully thought out and a plan of tabulation made that will clearly show the answers to the general questions it is desired to ask. The schedule should contain the items needed for tabulation and nothing more. It is a serious mistake to load up an inquiry blank with superfluous or useless questions. (b) The schedule must give due regard to precedents. It is of the highest importance that the data obtained by the particular study should be comparable with those obtained in similar previous studies. If the study is one of a series taken at regular intervals, changes in standardized schedule items should not be made unless results had shown the necessity therefor. The study may be enlarged by adding new items but the continuity of the series should be preserved. (c) The schedules should be as clear and simple as possible. The captions or questions should be short and leave no doubt as to their meaning. Where necessary, brief explanations should accompany the items. (d) Except in institutions, questions should not relate to the habits, ability or private life of those expected to answer. It is obvious that the one replying will not place himself in an unfavorable light. (e) Schedules should be printed on sheets or cards of standard size so that no difficulty will be found in obtaining filing cabinets in which they will fit. (f) If the schedules are elaborate and are to be filled out by many different persons, they should be accompanied by a booklet of detailed instructions covering all the questionable points that might arise. If enumerators are sent out from a central office they should be given full instructions before beginning the work.

Statistical schedules are filled out in various ways. Census blanks are taken from house to house by paid enumerators who write in the information obtained by direct questioning. They are instructed to make all necessary explanations and to require answers to the questions asked, as refusal to answer is made a misdemeanor. Thus little difficulty is experienced in securing complete data. Statistics of births and deaths are usually obtained from schedules filled out by attending physicians. Statistics of inmates of institutions are best prepared by having uniform schedules filled out and sent to a central statistical office. Elaborate statistical reports on prepared schedules are obtained by the Interstate Commerce Commission and by public service commissions from companies operating public utilities. In order to make the reports comparable, uniform systems of accounting have been devised for companies of the various classes. The data now being collected from such companies are noteworthy examples of the efficient use of statistical methods. Labor bureaus secure data relative to wages and employment by sending questionnaires to employers and to labor unions and by means of special agents. Social and philanthropic organizations make special statistical studies or surveys by the use of questionnaires sent out by mail or by means of investigations made by field workers; the latter although of limited scope is usually more successful. When the schedules have been filled out and returned to the statistical office they must be examined for errors and inconsistencies and corrected before tabulation is undertaken. In spite of every precaution some mistakes will occur on the schedules and some desired data will be unascertained.

Two methods are used in presenting statistical data to the general reader, namely, tabulation and charting; the former is the primary method and is almost universal; the latter is supplemental and of limited use. The preparation of effective statistical tables requires good judgment and a thorough understanding of the significance of the data and of the questions that are to be answered by the tables. Although the numerical table is an end in statistical work the plan of tabulation must be decided upon before the schedule is prepared. The latter must be so formulated that it will furnish the information needed for the table. Tabulations should be as simple as the data will permit and should show only significant aggregates. The necessity of making the data comparable with corresponding data in previous studies must be borne in mind. Tabulations may be made either by sorting by hand and counting or by machines specially devised for such purpose. The number of cards and the kinds of tabulations to be made determine the method to be used. In census work, where elaborate studies of millions of individuals are made, machines are indispensable. Machine tabulation necessitates the use of codes whereby the data on the schedule card may be transferred to the card to be used in the machine by punching holes at prescribed places. The punching machines and cards are made to meet the requirements of the sorting and tabulating machines. The electric tabulating machines will make cross tabulations at the rate of 250 to 400 cards per minute.

Statistical charts or graphs are used to illustrate statistical tables. They make clear and emphasize the principal numerical results shown in the tables. To be effective, statistical charts must meet certain definite requirements: (a) They must be self-explanatory. Charts are useless if they can be understood only after reading lengthy explanations in the text or footnotes. (b) They must be simple. Complicated charts are more difficult to understand than statistical tables, and therefore fail in their purpose. (c) They must have unity, i.e., not more than one principal theme should be portrayed on a single chart. A large variety of graphic forms are used in making charts, the most common of which are points, bars, curves, areas and maps. The kind of statistical results to be shown determines the form to be used in any case. To standardize the use of diagrams, a joint committee on standards for graphic presentation representing 17 national societies was appointed in 1915. A preliminary report of this committee sets forth the following principles as applicable to elementary graphic presentation:

> The general arrangement of a diagram should proceed from left to right.
>
> Where possible, represent quantities by linear magnitudes, as areas or volumes are more likely to be misinterpreted.
>
> For a curve the vertical scale, whenever practicable, should be so selected that the zero line will appear on the diagram.
>
> If the zero line of the vertical scale will not normally appear on the curve diagram, the zero line should be shown by the use of a horizontal break in the diagram.
>
> The zero lines of the scales for a curve should be sharply distinguished from the other co-ordinate lines.

For curves having a scale representing percentages, it is usually desirable to emphasize in some distinctive way the 100 per cent line or other line used as a basis of comparison.

When the scale of a diagram refers to dates, and the period represented is not a complete unit, it is better not to emphasize the first and last ordinates, since such a diagram does not represent the beginning or end of time.

When curves are drawn on logarithmic co-ordinates, the limiting lines of the diagram should each be at some power of 10 on the logarithmic scales.

It is advisable not to show any more co-ordinate lines than necessary to guide the eye in reading the diagram.

The curve lines of a diagram should be sharply distinguished from the ruling.

In curves representing a series of observations, it is advisable, whenever possible, to indicate clearly on the diagram all the points representing the separate observations.

The horizontal scale for curves should usually read from left to right and the vertical scale from bottom to top.

Figures for the scales of a diagram should be placed at the left and at the bottom or along the respective axes.

It is often desirable to include in the diagram the numerical data or formulæ represented.

If numerical data are not included in the diagram it is desirable to give the data in tabular form accompanying the diagram.

All lettering and all figures on a diagram should be placed so as to be easily read from the base as the bottom, or from the right-hand edge of the diagram as the bottom.

The title of a diagram should be made as clear and complete as possible. Subtitles or descriptions should be added if necessary to insure clearness.

Ratios and Averages.— In presenting statistical information to the public it is generally necessary to publish the detailed tables showing the results of the original compilation. Such tables show the numerical relation of totals to totals in one category of data, or of a part or parts to a total, or a part to a part, or of a number of one category to a number of another category. Ratios may be expressed by common fractions, decimals, percentages, or rates per 1,000 or per 100,000, etc. Percentages are most commonly used but death and birth rates are usually expressed by the number per 1,000 of general population; and death rates from single diseases, by the number per 100,000. A common form of ratio in business and economic statistics is the number per capita, as money in circulation per capita, as wealth per capita, etc. Crop yield may be expressed as bushels per acre or tons per acre. Density of population is indicated by number of persons per square mile. The ratio to be used in anv case is determined partly by custom and partly by the demands of clarity and conciseness of expression.

Averages form another indispensable aid to the statistician in the summarization of data. An average is a quantity which serves to characterize a number of divergent quantities. The purpose of averages is to express by a single item the net result of a series of items. The cipal forms of averages used in statistics are the simple arithmetic mean, the weighted arithmetical mean, the geometric mean, the median and the mode. The simple arithmetic mean is most widely used. It is computed by dividing the sum of a series of numbers by their number. The weighted arithmetic mean is found by multiplying the numbers of a series by coefficients or weights of different sizes and dividing the sum of the products resulting by the sum of all the coefficients. The weighted average is used in cases where it is desirable to give greater emphasis to some items than to others. The geometric mean of a series of *n* items is the *n*th root of the product of the items. The use of the geometric mean in statistics is limited. Its principal value has been found in the computation of index numbers. The median is that value which "has the central position in a series of items arranged according to size." (Czuber). It an odd number of items is arranged according to size, the median is the middle number of the series. If the number of items constituting the series is even, the median lies between the two central items. The median is less dependent upon extreme values than the arithmetic mean and may often be taken as typical of the series. The mode in a series of items is the value occurring most frequently and around which the other items are distributed most densely. As an average it is more typical than either the arithmetic mean or the median. The mode and median, however, can be computed only for a series of quantitative individual observations such as series of wages, incomes, etc.

Index Numbers.— Index numbers are used principally to indicate changes in prices or wages from one period to another. The prices of a certain period are arbitrarily taken as a standard and the index number of such period is fixed at 100. The prices in succeeding periods are computed as a percentage of those of the standard period, a general rise being indicated by an index number above 100 and a general decline by a number below 100. It is obvious that index numbers are valuable only for comparative purposes and that of themselves they give no indication of the values from which they are derived. The wide range of possibilities in the selection of commodities, prices and weights and in methods of computation has necessitated standardization of procedure which has been improved from time to time in recent years.

Dispersion.— Dispersion is a statistical term used to denote the variation in magnitude of the items constituting a series. It is measured by the difference in size of the extremes or by the general deviation of the items from the type. Such measurement may be absolute or relative. For purposes of comparison coefficients of dispersion are found by dividing the absolute measure of dispersion by the quantity representing the typical item. The most common measures of dispersion are known as the average deviation and the standard deviation; the former is found by dividing the sum of the deviations of the several items from the arithmetical mean, without regard to signs, by the number of items; the standard deviation is computed by dividing the sum of the squares of the several deviations from the arithmetical mean by the number of items and extracting the square root of the quotient. In series where the items represent different frequencies the standard deviation is found by multiplying the squares of the several deviations by the corresponding frequencies and dividing the sum of the products by the total frequencies and extracting the square root of the quotient.

Skewness.— Skewness in statistics denotes asymmetrical dispersion or that at points of like deviation above and below the mode the frequencies are unequal. Skewness is measured in various ways, the simplest measure being indicated by the difference between the arithmetical mean and the mode. The simplest coefficient of skewness is found by dividing the difference thus found by the average deviation from the mode. Other coefficients are found by more complicated mathematical processes.

Correlation.— The determination of the causal relationship between two or more groups of phenomena known as correlation, constitutes one of the principal developments of statistics in recent years. While statistics alone are not able to prove causal relationships absolutely, they are able with other factors to furnish satisfactory demonstrations of the fact and extent of correlation in many realms of phenomena. Correlation between two statistical series may be shown by diagrams or by computation of the coefficient of correlation. The former method is used in statistical work designed for the general reader, as the correspondence of the two frequency curves on the diagram is recognized at a glance. The second method is used in cases where a definite measure of correlation is desired. The formula most commonly used in computing coefficients of correlation is that devised by the biologist Karl Pearson. Without attempting a full mathematical demonstration the method of computation may be briefly described as follows: Two series of items of equal length representing two groups of phenomena are taken. The one group may be designated as group A and the other as group B. The deviations from the arithmetical mean of the several items of each group are determined. The deviations in group A may be designated by x_1, x_2, x_3, etc., and those of group B by y_1, y_2, y_3, etc. The several deviations of the items of group A are multiplied by the deviations of the corresponding items of group B and the products are added. This summation of products is designated as $\Sigma(xy)$. The standard deviation of group A is designated as σ_1 and that of group B as σ_2. The number of items is denoted by n.. Then r, the coefficient of correlation of groups A and B, is determined by the following formula, $\frac{\Sigma(xy)}{n\sigma_1 \ \sigma_2}, = r$, stated in words, the sum of the products of the deviations as above obtained is divided by the product of the number of items and the standard deviations of the two groups. Modifications of the method are used in dealing with various kinds of phenomena, and elaborate formulæ have been devised to determine the coefficient of correlation of three or more groups of phenomena. Through the work of Pearson, Bowley, Yule, Persons and others, rapid development has taken place in mathematical statistics during recent years. Much of the work in this field, however, is of a theoretical nature and has limited application in general statistics.

History.— The beginnings of statistics are found in very early times. The ancient Egyptians compiled data concerning population and wealth preparatory to the building of the Pyramids, about 3050 B.C. There are accounts of statistical works in China as early as 2300 B.C. Two censuses of the Israelites are recorded in the book of Numbers. A census was taken in Greece for the purpose of levying taxes in 594 B.C. Athens took a census of population in 309 B.C. The Romans excelled every other nation of antiquity in making definite measurements. Besides making quinquennial enumerations of the population, they prepared surveys of the entire country including parts of the provinces. They also kept records of births and deaths. It was many centuries after the fall of the Roman Empire before another comprehensive system of governmental statistics was established. Very few statistical records of value were made during the Middle Ages but occasional investigations were ordered by sovereigns. Pepin the Short in 758 and Charlemagne in 762 ordered the detailed description of church lands. The registries of lands in France taken at these and succeeding periods known as «Polyptiques» included an enumeration of the rural population. The best known census of this period is the «Domesday Book» prepared by order of William the Conqueror in 1088 A.D. The purpose of this was to acquaint the sovereign with the extent of his new dominion and the tenure of the various parcels of land. Sebastian Muenster, a Heidelberg professor, anticipated the field of comparative statistics by preparing a systematic treatise on the organization, wealth, armies, commerce, laws, etc., of ancient countries. Francesco Sansovino published a similar work in 1562, and Giovanni Botero, another in 1589. Pierre d'Avity, Seigneur de Montmarin, compiled a much more comprehensive and accurate treatise in the same field in 1614. The registration of deaths was begun in London in 1532 and was followed by that of baptisms by parish clergymen. In 1629 the distinction of sex was made in the record. In 1661 a noteworthy statistical advance was made by the publication by Capt. John Graunt of his 'Observations' on the London Bills of Mortality. He was the first to point out the regularity of social phenomena and the excess of male births over female. Caspar Neumann of Breslau in 1691 compiled data relative to 5,869 deaths from the parish records of that city and pointed out that the supposed fateful significance of the years seven and nine was unfounded. His work attracted the attention of Edmund Halley, the astronomer, who laid the foundations of scientific life insurance by calculating a mortality table from the data collected. Another noteworthy contribution of this period was the mathematical demonstration of the theory of probabilities by Jacques Bernouilli, a professor of Basel. The first to use the word *statistik* was Gottfried Achenwall, (1719–72) a professor of philosophy at the University of Göttingen. The word comes from the Italian *statista*, which denoted statesman. Achenwall in his book discussed matters that he believed of interest to the state, such as population, resources, constitutions, etc. The name statistics was introduced into England by Dr. Zimmerman about 1787 and was popularized by Sir John Sinclair in his 'Statistical Account of Scotland' (1791–99). Writings more of the nature of modern statistics are found in Sir William Petty's 'Political Arithmetick' (1691) and Süssmilch's 'Betrachtungen über die göettliche Ordnung in den Veränderungen des menschlichen Geschlechts aus der Geburt, dem Tode und der Fortpflanzung desselben erwiesen' (1741). The close of the 18th century and the beginning of the 19th marked the revival of census taking. The United States took its first decennial census of population in 1790. England and France began periodic census taking in 1801. The former country has continued the practice at 10-year intervals, but the latter after taking a second census in 1806 took no further enumerations of population until 1836. From that year to 1901 four general censuses were taken; since 1901 a census of population has been taken in France every five years. Belgium took its first census in 1829. The analysis of this census by Quetelet contains noteworthy observations on the influence of age, sex, occupation, economic condition and season upon mortality. Upon the organization of the Belgium Statistical Central Commission in 1841, Quetelet became its president and continued to hold the office until his death in 1874. His work not only placed the statistics of his native country on a high plane but did much to raise the standards of statistical work throughout the world. The progress of statistics was accelerated by the founding of the Société de Statistique de Paris in 1803, the Royal Statistical Society of London in 1834, and the American Statistical Association in 1839. Each of these societies holds meetings periodically and publishes the papers presented by its members. The first meeting of the International Statistical Congress was held in Brussels in 1853. After holding eight additional meetings it was succeeded by the International Statistical Institute in 1885. These societies have done much to promote uniformity in statistical classifications, schedules and tables, and otherwise to advance the science. Since 1890 there has been wonderful expansion in the field of statistics. Practically every civilized country now takes periodic enumerations of its population, keeps continuous records of births, deaths, marriages and divorces, and prepares elaborate statistics relative to production, foreign and domestic commerce, finance, public utilities, labor, agriculture, education, immigration, etc. The United States made a great advance in 1902 by making the Census Bureau a permanent office. Previous to that time the bureau was organized anew every 10 years for the purpose of taking the general census and was discontinued when the work was completed. While national statistics has been expanding there has been an equally great extension of statistical work in States and cities. Massachusetts took the lead in State statistics by establishing a permanent bureau of statistics and labor in 1869. A similar bureau was established by Pennsylvania in 1872, by Connecticut in 1873, and by Ohio in 1877. Subsequently several other States took like action. With the enlargement of State activities during the past 30 years the need of adequate statistics has been met, in part at least, by creating bureaus of statistics within State departments. These bureaus publish annual statistics relating to finances, taxation, banking, insurance, intra-State commerce, labor conditions, public utilities, education, dependents, delinquents, defectives, deaths, births, disease, accidents, etc. Scarcely less important are the valuable statistics prepared by the principal cities of the country. These statistics deal with the functions of the city and the problems that the city is required to solve, such as education, housing, transportation, docks, pavements, water supply, electricity, gas, crime, fires, accidents and diseases. Noteworthy contributions to statistics are being made by various organizations such as insurance companies, banking houses, national sociological and philanthropic societies, etc. The insurance companies especially have done remarkable work in studying health conditions in various parts of the world.

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STATIUS, stā'shĭ-ŭs, **Publius Papinius**, Roman poet: b. Naples, 61 A.D.; d. 101 A.D. His principal productions are two epic poems — the 'Thebais,' in 12 books, treating of the war of the seven princes against Thebes; and the 'Achilleis,' in two books, relating the achievements of Achilles, and incidents in his life previous to the Trojan war. The latter is unfinished. The style of Statius is bombastic and affected, often exhibiting the art of the declaimer rather than that of the poet; but he attracted general admiration in his own time, and even some modern critics have considered him inferior only to Virgil. He wrote some shorter poems, called 'Silvæ,' which have been distributed into five books, and some of these compositions are beautiful. A modern edition of the complete works of Statius is that of Queck (Leipzig 1854); and of the 'Silvæ,' the best are those of Markland (London 1728); Sillig (Dresden 1827); Bachrens (Leipzig 1876); Vollmer (Leipzig 1898); Klotz (Leipzig 1900); and Phillimore (1904); Pope, Howard, Lewis, Stater and Stephens have made translations from Statius. Consult Butler, E. H., 'Post-Augustan Poetry' (Oxford 1909); Schanz, M., 'Geschichte der römischen Litteratur' (Munich 1913); Teuffel, W. S., 'Geschichte der römischen Litteratur' (Leipzig 1910).

STATUARY HALL, National, the popular name of the historic chamber formerly used by the House of Representatives at Washington, and now utilized for the preservation of the statues of historic Americans. In this chamber Madison was inaugurated President in 1809 and again in 1813; and there Monroe was inaugurated for his second term in 1821, and there Millard Fillmore took the oath of office as President on 10 July 1850, following the death of President Taylor. This is the hall in which Henry Clay presided as speaker of the House in the old days. There occurred the stormy debates incident to the War of 1812 and the war with Mexico and the preliminary struggles over the vexed question of slavery. There Daniel Webster and later Abraham Lincoln sat as obscure congressmen, each before the day of his meridian fame. There John Quincy Adams was chosen President in 1825 over Andrew Jackson and William H. Crawford, when the election was thrown into the House of Representatives. By the terms of an Act of Congress approved by President Lincoln on 2 July 1864, the chamber was officially designated as a national statuary hall, and an invitation was extended to all the States to contribute statues to be set up therein. Some 47 statues have been contributed by the different States of the Union; but the result of these contributions has not been altogether happy historically or artistically.

STATUTE, a law proceeding from the government of a state; a written law. Some ancient statutes in Europe are in the form of charters or ordinances, proceeding from the Crown. Statutes are either public or private (in the latter case affecting an individual or a company); but the term is usually restricted to public acts of a general and permanent character. Statutes are said to be declaratory of the law as it stood before their passing; remedial, to correct defects in the common law; and penal, imposing prohibitions and penalties. The term statute is commonly applied to the acts of a legislative body consisting of representatives. In monarchies not having representative bodies, the laws of the sovereign are called edicts, decrees, ordinances, rescripts, etc. See Law.

STAUNTON, stân'tŏn, **Sir George Thomas,** English traveler and Orientalist: b. near Salisbury, 26 May 1781; d. London, 10 Aug. 1859. He was the son of Sir George Leonard Staunton, 1st baronet, diplomat and Orientalist, and in 1792 accompanied his father to China and the Far East. He learned Chinese, returned to England for study at Trinity College, Cambridge, in 1797, and in 1798 entered the service of the East India Company, Canton, China. He succeeded his father as baronet in 1801, and in 1805, through his translation of Dr. George Pearson's treatise on the subject, was the means of introducing vaccination for smallpox into China. He returned permanently to England in 1817; served in Parliament in 1818–26, 1830–31, 1832–35 and 1838–52. He served on the East India Committee, and was one of the founders of the Royal Asiatic Society in 1823. He made the first translation of a Chinese work into English 'Ta Tsing leu lee, Being the Fundamental Laws of China' (1810); and was author of 'Miscellaneous Notices Relating to China' (1822); 'Notes of the British Embassy to Peking' (1824); 'Observations on Chinese Commerce' (1850), etc.

STAUNTON, Howard, English Shakespearean editor and pre-eminent as a chess-player: b. England, 1810; d. London, 22 June 1874. He was educated at Oxford, after leaving which he settled in London, and devoted himself to literary pursuits, and to chess, becoming the champion chess-player of his day. His first important publications were 'The Chess-player's Hand-book' (1847); 'Chess-player's Companion and Chess-player's Text-book' (1849); 'Chess Tournament' (1852); 'Chess Praxis' (1860). Before the appearance of the last work he had begun the publication of an edition of Shakespeare, 1857–60, which was generally considered by the Shakespearian scholars of the day to furnish the best text that had till then been published. Later studies were given to the world in a series of papers on 'Unsuspected Corruptions of Shakespeare's Text,' begun in the 'Athenæum' in October 1872, and continued to the time of his death. He published 'Great Schools of England' (1865), and from 1844 till his death edited the chess column in the *Illustrated London News*. 'The Theory and Practice of Chess,' by Staunton and Wormald, appeared in 1876.

STAUNTON, Ill., city in Macoupin County, 37 miles northeast of Saint Louis, Mo., on the Litchfield and Madison and the Wabash railroads. Its industries are derived from the neighboring coal mines, gas and oil wells. It was settled in 1830. Pop. 6,495.

STAUNTON, Va., city, county-seat of Augusta County, on the Chesapeake and Ohio and on the Valley Branch of the Baltimore and Ohio railroads, about 40 miles northwest of Charlottesville and 55 miles north of Lynchburg. It was settled in 1745 by people from the northern part of Ireland. In 1802 it was incorporated and in 1871 it was chartered as a city. From its importance as a strategical point Staunton became the objective point of many campaigns of the Civil War, but was not occupied by the Union troops until 6 June 1864, when General Hunter entered the place without opposition and, after destroying the railroad several miles east and west of the place, and burning much public property and many warehouses, marched toward Lynchburg. (See Piedmont, Battle of). It was again occupied by General Sheridan's cavalry 2 March 1865, and the railroad and public property were again destroyed. (See Waynesborough, Battle of; Shenandoah Valley, Military Operations in). Woodrow Wilson was born in Staunton. It is in an agriculture region and has considerable manufacturing interests. Its chief manufactures include chemicals, bricks, pennants, flour, organs, machine shop, foundry products, canned goods, agricultural machinery. The principal public buildings are the Western State Hospital for Lunatics, the Virginia School for the Deaf and Blind, 16 churches, and the schools. The educational institutions are the State school mentioned, the Mary Baldwin Seminary, Virginia Female Institute, Staunton Military Academy, two business colleges, two other private schools, and public and parish schools. The four banks have a combined capital of $600,000; the annual amount of business is about $30,000,000. The government is vested in a mayor and a council of 12 members, each of whom holds office two years. Pop. about 12,000.

STAUROLITE, STAUROTIDE, CROSS-STONE, or **FAIRY-STONE,** a mineral very frequently found in cross-shaped, penetration twins, whence its name (from Greek, *stauros*, a cross; *lithos*, a stone). It crystallizes in the orthorhombic system, the simple crystals being short prisms. Besides the twins above mentioned other forms abound. The crystals are usually rough and of a dark reddish-brown to brownish-black color. Hardness 7 to 7.5; specific gravity, 3.65 to 3.75; lustre somewhat resinous. It is a silicate of aluminum, iron and magnesium. It abounds in many of the crystalline schists, such as mica schist, argillaceous schist, and gneiss. Important occurrences are Monte Campione, Switzerland, and Fannin County, Ga., and in scores of localities in New England and North Carolina. It occurs sparingly in Brazil and North Carolina in transparent fragments which yield gems remarkable for their green to reddish-brown pleochroism.

STAVANGER, stä-väng'gĕr, Norway, capital of Stavanger County, a seaport on Bokn Fjord, 105 miles northwest of Christiansand. It has two excellent harbors with quays and docks, and is protected by islands. The Bay of Dusevik is a rendezvous for warships, and is visited more than any other port of Norway by merchant vessels. The principal buildings are the ancient Gothic cathedral, Saint Peter's Church, several schools, museum, hospital and mechanics' institute. The chief articles of export are herrings, anchovies, lobsters, sheep, butter, fertilizers and preserved foods, marble, oil and hides. There are some manufactures of woolen, linen and cotton goods, soaps, preserves, butter, oleomargarine, bricks, hardware, iron foundries and pottery, and distilleries, ship-building yards, a repairing slip and foundries. Kjelland, the novelist, was born at Stavanger. Pop. about 40,000.

STAVESACRE, a larkspur (*Delphinium staphisagria*), native to the Mediterranean region, whose seeds have been used medicinally since ancient times. It is a pubescent plant, about two feet high, with purplish flowers in terminal racemes. The seeds are grayish brown, reticulated with ridges, oily, and have an acrid and biting taste. They contain the poisonous principle delphinine, but were used as a purgative and emetic; being too powerful, their use at present is confined to an external remedy, in tincture, for rheumatism, and, in powder or ointment for killing parasitic vermin.

STAVROPOL, stäv'rō-poly, Russia, in the Caucasus, (1) capital of the government of Stavropol, on the Atchla, 307 miles southwest of Astrakhan. It is the seat of a Greek-Catholic bishop and is a well-built town. The schools include gymnasia for both sexes, and several town and industrial schools; there are also several libraries, and a people's palace. The manufactures comprise soap, leather and flour-mills, and there is considerable trade in hides, tallow and corn. The town was founded in 1776, and, on the commercial route between Russia and Persia, has flourished. Pop. over 60,000, (2) The government of Stavropol covers 23,398 square miles. The rainfall is scant, forests rare, the fauna and flora differ from other sections of the Caucasus, somewhat resembling central Asia. The inhabitants include Armenians, Greeks, Poles and Russians, about one-third being nomadic. On the wide prairies agriculture is carried on, and for this purpose various machines and implements are manufactured, and the products form the exports. Interesting is the communal tillage of lands, for the reserve fund of grain. The main streams are the Kuma and tributaries, and in this section are the best lands. The Mantych is a lake-formed river, once a connecting link between the Black and Caspian seas. Near the Caspian are some unimportant salt lakes. Other small streams water the country at the west. The climate is characterized by sudden changes. Stavropol was early colonized but unsuccessfully, until the military colonies of Cossacks (1711) were established. After the emancipation of the serfs, immigration increased rapidly, and still grows. Population 1,300,000, principally Russians.

STAWELL, stä'ĕl, a town of Victoria, Australia, 176 miles by rail northwest of Melbourne. The chief buildings are the municipal offices, some churches, mechanics' institute and theatre. The great quartz reefs of the Pleasant Creek gold-fields are extensively exploited, and large cyanide works are operated. Agriculture is an important industry; wheat, and vine-culture is especially carried on.

STEAD, stĕd, **Albert,** English journalist and author, son of W. T. Stead (q.v.): b. 1877. He was educated at University College, London, and afterward served on the *Review of Reviews* under his father. He was sent as a correspondent to the different British possessions, and to the near and the far East. He became well versed in international politics, and lent his aid as a journalist to the Anglo-Japanese Alliance, and to the restoration of diplomatic relations between England and Serbia, which were broken upon the accession of King Peter after the murder of King Alexander and his consort. He was consul-general for Rumania in London in 1907–11; and in 1912–13 he was editor of the *Review of Reviews*. He was joint author of ‹South Africa› (1899); and author of ‹China and Her Mysteries› (1901); ‹Japan, Our New Ally› (1902); ‹Great Japan› (1905); ‹Modern Roumania› (1908); ‹Servia by the Servians› (1909); ‹My Father› (1913), etc.

STEAD, Francis Herbert, English Congregational clergyman and social reformer: b. Howdon-on-Tyne, Northumberland, 20 Oct. 1857. He was educated at Owens and Airedale colleges, Glasgow University and at the leading universities of Germany. He entered the Congregationalist ministry in 1884; was pastor at Leicester in 1884–90; and in 1890–92 edited the *Nonconformist and Independent*. He was appointed warden of the Robert Browning Settlement in 1894. He was instrumental in securing the appointment of the National Committee on Old Age Pensions in 1898; commenced an agitation for national old age homes in 1913; and in 1916 was convener of the League to Abolish War at a Third Hague Conference. He has written ‹Hand Book on Young People's Guilds› (1889); ‹How Old Age Pensions Began to Be› (1909); ‹No More War, a Novel› (1917).

STEAD, William Thomas, English journalist: b. Embleton, 5 July 1849; d. at sea 15 April, 1912, one of the victims of the *Titanic* disaster. His father was a Congregational clergyman. He became editor of the *Northern Echo*, 1871; assistant editor *Pall Mall Gazette*, 1880, and in January 1890 founded the *Review* *of Reviews* and similar publications in the United States and Australia. In July 1885 he published 'The Maiden Tribute to Modern Babylon.' For some of his acts in procuring evidence for this book he was arrested and imprisoned for three months. In 1893 he founded *Borderland,* a magazine devoted to occult subjects. He introduced American newspaper methods and ideas into England and he exercised a powerful influence on the government, which he was accused of, at times, forcing to do his will. He was noted as an advocate of permanent international peace and an undaunted champion of reform of social evils and civic administration. He wrote 'If Christ Came to Chicago'; 'The Pope and the New Era'; 'No Rent'; 'No Reduction'; 'Truth About Russia'; 'The Story that Transformed the World'; 'The Labor War in the United States'; 'Satan's Invisible World'; 'The United States of Europe'; 'Mr. Carnegie's Conundrum'; 'The Americanization of the World'; 'Peers or People'; 'Mrs. Booth'; 'The Despised Sex'; 'The Last Will and Testament of Cecil John Rhodes.' In 1898 his *War against War,* a weekly magazine, was founded to oppose the Anglo-Boer War. Consult Stead, Estelle W., 'My Father' (London 1913).

STEAM. Steam is water in a gaseous state. It liquefies at a temperature of 100° C., or 212° F., under a pressure of one atmosphere at the sea-level, namely, 14.7 pounds per square inch. High pressure and low pressure steam once meant steam used at pressures above or below this point. An engine which exhausted its steam into the open air — that is, at ordinary atmosphere pressure — was known as a high-pressure engine; an engine which exhausted into a condenser, where a partial vacuum was maintained, was called a low pressure engine. But these terms have lost their former significance. Absolute steam pressure is the total pressure computed from the zero of an absolute vacuum, as distinguished from relative pressure at sea-level. Ordinary steam-gauges indicate pressure above that of the atmosphere. To this must be added the pressure of the atmosphere in order to obtain the absolute steam pressure. The temperature of steam is sometimes expressed in degrees «absolute,» meaning the number of degrees above «absolute zero», which is, on the Fahrenheit scale, — 460°; that is, 460 below the zero mark on a Fahrenheit thermometer.

Saturated steam is steam at its greatest density and pressure at the particular temperature existing: that is, any increase in pressure or any lowering of temperature would cause condensation — a part of the steam would return to the condition of water. If saturated steam holds in suspension less than 3 per cent of unvaporized water, it is known as dry steam; if 3 per cent or more of water is present it is termed wet steam. Dry steam as it issues from a jet into the air is colorless: wet steam issues as a white cloud. The presence of free water in steam is highly objectionable. It represents a loss of heat without production of useful work, and to that extent reduces the efficiency of the boiler and increases the cost of the steam actually used. Further, it adds to the amount of water of condensation to be cared for; increases the wear of valves and valve-seats; washes away lubrication; and, in the case of turbines. erodes the blades almost as if they had been subjected to a sandblast.

When a space is saturated with steam the pressure exerted is known as saturation pressure. If the content of a space which is saturated with steam be reduced, some of the steam is condensed to a liquid state, but the pressure remains the same. If the volume of the space be increased, provided that it contains sufficient liquid, more water evaporates and the pressure exerted by the water vapor soon attains the same value as before the change of volume. If the temperature of a space containing water, and its saturated vapor be raised, the saturation pressure of the vapor is increased; if on the other hand the temperature falls, some of the vapor is condensed, and the saturation pressure is less.

Superheated steam is saturated steam heated until it resembles a perfect gas. The superheating of steam is accomplished by «drying» it of the water vapor, or by relieving it of some of the pressure upon it. The former method is the one used in steam practice. The drying cannot be done while the steam is in contact with the water in the boiler, for any increase of heat applied to the latter goes to forming more saturated steam, the temperature remaining relatively the same — that is, according to the pressure. While saturated steam begins to condense at once upon loss of heat superheated steam retains its gaseous form until it has lost all its heat above 212°. This quality of steam makes it of great value in engines, the expansion in the cylinder being wholly gaseous, and without leaving any water of condensation — the source of the largest loss of efficiency in engines. The superheating of steam is commonly accomplished by passing it through a grid of pipes open to the fire. In ordinary engine practice the effect of superheated steam is secured by «wire-drawing» it — the term signifying the causing it to pass through a (relatively) very small opening. This is done on an engine by partly closing the throttle valve. The temperature remaining the same, the small fall in pressure results in superheating the steam allowed to pass through the valve.

Superheated steam has a lower thermal conductivity than saturated steam, and this quality reduces the leakage of heat to the cylinder walls by 12 per cent. The radiation from pipes carrying superheated steam is less, also. The fuel expense of superheating steam is not large: the amount of fuel required to raise steam to 100° of superheat — that is, to 312°, being an increase of only 5.69 per cent over that required to produce the saturated steam of 212°. The limit to which superheat may be added to water confined in a boiler is about 600°, equivalent to a pressure of 1,574 pounds per square inch. Above this point the proper lubrication of the cylinders of reciprocating engines, and the maintenance of packings of valves and condensing apparatus in normal condition is impracticable. The practical limit of safe pressure in modern boilers is 200 pounds per square inch, equivalent to a temperature of about 380°, or 168° of superheat. In the United States the range of superheat practice does not exceed 500 degrees, and there are few instances in which it exceeds 450°. In Europe, however, few plants are installed without superheaters, and the temperatures range from 600° for ordinary to 850° as the top limit. For these very high pressures specially built boilers are required, and the extra cost of such work offsets the advantages which may be gained. "Live steam" is steam which has performed no work, or rather which is available for the performance of work. Steam which has performed work is called exhaust steam. When a pound of water at 212° is turned into steam at 212°, 965.7 heat units are absorbed in the change of form. This energy reappears when the steam returns to the form of water. Herein lies the vast economic profit in the utilization of exhaust steam in the heating of feed water for the boiler, warming the shop, etc. Every pound of exhaust steam has within itself the potency of 751,314.6 foot-pounds of heat energy, imparted to it by the fuel. If even but a part of this latent heat energy can be used, an equivalent amount of fuel is saved, or, what practically amounts to the same thing, so much of the fuel is used twice.

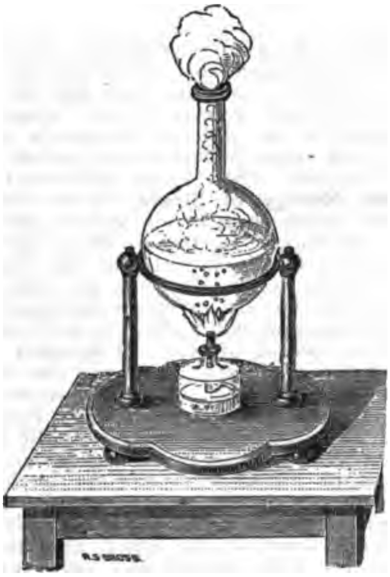

FIG. 1.

Vaporization.— When heat is applied to water, a point is reached at which the heat overcomes the cohesion and the pressure of the atmosphere, then the water passes into vapor. Evaporation takes place at the surface of the water. Its rapidity varies with the temperature and the pressure upon that surface. When a flask containing water (see Fig. 1) is placed over the flame of a lamp, the air dissolved in the water is first driven off, then as the temperature of the water rises, the liquid molecules in contact with the bottom of the flask become so hot that the heat is able to overcome their cohesion, the weight of the overlying water and the pressure of the atmosphere above the water. At this temperature the change from a liquid to a gaseous state takes place beneath the surface, the steam rising to the surface and escaping with ebullition.

The boiling point — that is, the temperature at which steam is formed, depends on the pressure under which it is generated. If the water is confined to a limited space, as in a boiler, if the pressure above it is relieved with an airpump, the boiling point will be lowered. If pressure is brought to bear on the water in the boiler, the boiling point is raised. This is, in effect, what happens in ordinary boiler practice: the pressure is increased by making more steam than there is room for in the boiler above the water. The steam being compressible, accumulates in a state of compression, and the boiler pressure rises, as shown by the steam-gauge. The following table gives the relations between pressure, volume and total heat of steam for temperatures between 32° F. and 428° F. During the first stage of heating, all the heat sensibly goes into increasing the internal energy of the fluid. This is represented in the last column of the table. During the second stage the heat taken in is known as latent heat of steam. The total heat of both stages is represented by the numbers in the fourth column of the table. The latent heat of the steam is determined by subtracting the heat content of the liquid from the heat content of the steam.

TABLE I.

Temperature in degrees Fahrenheit	Pressure per square inch in pounds	Volume per pound in cubic feet	Total heat content of steam	Heat content of water
32........	0.089	3,296.00	1,073.0	0.00
41........	0.127	2,352.00	1,077.4	9.06
50........	0.178	1,702.00	1,081.5	18.08
59........	0.247	1,248.00	1,085.8	27.08
68........	0.340	926.00	1,089.9	36.08
77........	0.459	695.00	1,094.1	45.06
86........	0.615	527.20	1,098.2	54.04
95........	0.815	404.20	1,102.3	63.01
104........	1.069	313.06	1,106.4	71.99
113........	1.389	244.70	1,110.4	80.96
122........	1.788	192.90	1,114.4	89.93
131........	2.281	153.40	1,118.4	98.91
140........	2.887	123.00	1,122.3	107.89
149........	3.625	99.40	1,126.1	116.88
158........	4.518	80.80	1,130.0	125.88
167........	5.589	66.23	1,133.7	134.88
176........	6.870	54.62	1,137.5	143.89
185........	8.380	45.33	1,141.1	152.90
194........	10.170	37.84	1,144.7	161.92
203........	12.260	31.76	1,148.3	170.96
212........	14.700	26.81	1,151.7	180.00
221........	17.520	22.75	1,155.2	189.00
230........	20.780	19.39	1,158.5	198.10
239........	24.530	16.61	1,161.7	207.20
248........	28.800	14.29	1,164.9	216.30
257........	33.670	12.35	1,167.9	225.40
266........	39.190	10.71	1,170.9	234.50
275........	45.420	9.33	1,173.8	243.70
284........	52.430	8.16	1,176.5	252.80
293........	60.280	7.15	1,179.2	262.00
302........	69.100	6.30	1,181.8	271.30
311........	78.800	5.56	1,184.2	280.50
320........	89.700	4.92	1,186.5	289.80
329........	101.600	4.37	1,188.6	299.20
338........	114.900	3.89	1,190.7	308.50
347........	129.400	3.48	1,192.5	317.80
356........	145.400	3.11	1,194.3	327.20
365........	162.900	2.79	1,195.9	336.70
374........	182.000	2.51	1,197.3	346.20
383........	202.700	2.26	1,198.6	355.70
392........	225.300	2.04	1,199.7	365.20
401........	249.800	1.69	1,200.6	374.80
410........	276.300	1.67	1,201.4	384.40
419........	306.040	1.52	1,202.0	393.80
428........	340.100	1.38	1,202.3	403.70

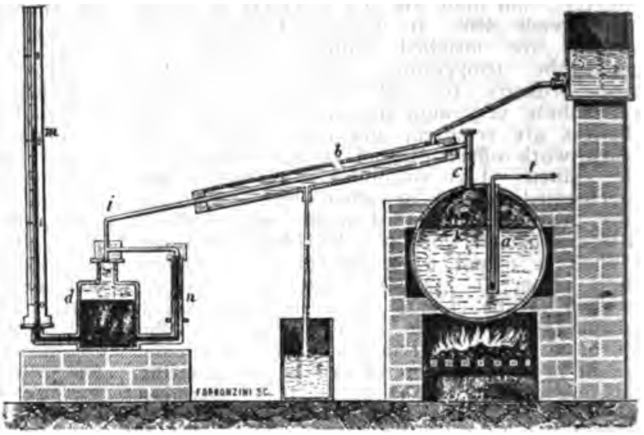

FIG. 2.

Dulong and Arago determined the tension of steam many years ago by means of the apparatus shown in Fig. 2.

In the figure (*k*) is a copper boiler, with a tube (*a*) containing a thermometer (*t*), which measures the temperature of the water, and its vapor. The tension of the steam is measured by a manometer (*m*). The steam passing through the tube (*c*) exerts a pressure on a column of water in the tube (*i*). This pressure is further transmitted to the mercury in the vessel (*d*), and thence to the manometer. By taking the manometer readings corresponding to each degree of the thermometer, a direct measurement of tension was obtained up to a pressure of 24 atmospheres, and from this on by calculation. The following is a table of results:

TABLE II.

Temperature	Number of atmospheres	Temperature	Number of atmospheres	Temperature	Number of atmospheres	Temperature	Number of atmospheres
100.0°	1	170.8°	8	198.8°	15	217.9°	22
112.2	1½	175.8	9	201.9	16	220.3	23
120.6	2	180.3	10	204.9	17	222.5	24
133.9	3	184.5	11	207.7	18	224.7	25
144.0	4	188.4	12	210.4	19	226.8	26
152.2	5	192.1	13	213.0	20	228.9	27
159.2	6	195.5	14	215.5	21	230.9	28
165.3	7						

Regnault, 14 years later, devised a method by which the vapor of water could be measured at temperatures above or below boiling point. By this method the following tensions were obtained for temperatures ranging from 10° below to 101° above zero, of the Centigrade scale.

TABLE III.

Temperatures, degrees	Tensions in millimeters	Temperatures, degrees	Tensions in millimeters	Temperatures, degrees	Tensions in millimeters	Temperatures, degrees	Tensions in millimeters
—10	2.078	12	10.457	29	29.782	85	433.41
8	2.456	13	11.602	30	31.548	90	525.45
6	2.890	14	11.906	31	33.405	91	545.78
4	3.387	15	12.699	32	35.359	92	566.76
2	3.955	16	13.635	33	37.410	93	588.41
1	4.600	17	14.421	34	39.565	94	610.74
+1	4.940	18	15.357	35	41.827	95	633.78
2	5.302	19	16.346	40	54.906	96	657.54
3	5.687	20	17.391	45	71.391	97	682.03
4	6.097	21	18.495	50	91.982	98	707.26
5	6.534	22	19.659	55	117.478	98.5	720.15
6	6.998	23	20.888	60	148.791	99.0	733.21
7	7.492	24	22.184	65	186.945	99.5	746.50
8	8.017	25	23.550	70	233.093	100.0	760.00
9	8.574	26	24.998	75	288.517	100.5	773.71
10	9.165	27	26.505	80	354.643	101.0	787.63
11	9.792	28	28.101				

In the making of steam in boilers it is of the greatest importance that clean, soft water be used. The condensation of the salts in boiler water eventually reaches a point where they are deposited as scale on the inside of the plates and tubes, a condition in which much fuel is wasted. (See WATER SOFTENING).

The Energy of Steam.— Water has the greatest specific heat of any known substance, except hydrogen. By this we mean that more heat enters into it, in order to raise its temperature one degree, than into any other substance, with the one exception mentioned. Its stored energy as noted above is 965.7 thermal units per pound of water, Fahrenheit scale. It is easily condensed, giving out this energy. These facts, together with its universal and abundant presence in large quantities, have rendered steam, up to this time, a favorite means for the generation of mechanical power. The process of changing steam into mechanical power may be briefly outlined as follows: If we start with water at 32° F. and apply heat, the temperature of the water will rise one degree for each thermal unit, but expansion does not begin until 38° to 40° of temperature are reached. When 180½ units of heat have been absorbed the temperature of the water will be found to be 212° F. and its expansive force (into a vacuum) equal to 14.7 pounds to the square inch, or that of the atmosphere at sea-level. At this point the water is incapable of becoming any hotter under that pressure. The heat added, after that point is reached, is used in converting the water into steam, and 965.7 thermal units are required for each pound of water thus converted. This so-called latent heat is stored energy, to be given back again in mechanical work and heat, as the steam is condensed. If we enclose both water and steam in a boiler of suitable construction, and continue heating, part of the water will be vaporized, but being prevented by the confined space from expanding, it crowds the steam already enclosed into a smaller volume and the pressure upon the surface of the water is increased so that the heat now added increases temperature again. When we have added 1,188.6 total thermal units (including temperature and latent heat) the pressure or energy of the steam will be equal to 101.6 pounds to the square inch and the temperature will have risen to 329° F. (See table I, columns 1, 2 and 4).

We have now to consider how this energy is transformed. When the steam in the cylinder of an engine performs work by pushing the piston against a resistance, that work robs the steam of a portion of its heat, hence the steam is condensed. Theoretically, it requires two and a half pounds of steam, saturated, to supply one horse power of work each hour; but practically, from 5 to 25 times that amount is required to pass through an engine in order to secure this result.

This is due to the loss of the energy of the steam, in giving up its heat to the walls of the cylinder, and to the immense portion of the steam which acts only as backing. In the best quadruple engines of to-day less than one-fifth of the energy of the steam is converted into actual work, and in the best non-condensing engines only one-tenth. The waste is enormous, but the abundance of the supply in part compensates for it.

According to the 1914 census of manufactures the number of steam engines and steam turbines employed in manufacturing in the United States was 137,176, and the total horse power developed was 15,681,688 or 69.5 per cent of all forms of power in the country. A large amount of steam is used, in addition to this, for heating purposes. Its value in this respect is due to its being able to carry more heat for a given weight than any other substance, and when it has given up its heat to drop out of the way, by condensation, and make way for a fresh supply. Steam is also used extensively in extracting processes. It is often injected directly into a liquid, bubbling through it and carrying over certain constituents to be released in the condensing chamber. In other cases, especially those of liquids boiling at a lower temperature than water, coils of steam pipes supply the mild degree of heat needed for a gentle distillation. Consult Goodenough, G. A., 'Properties of Steam and Ammonia' (New York 1915); Hausbrand, E., and Wright, A. C., 'Evaporating, Condensing and Cooling Apparatus' (London 1916); Holmes, U. T., 'Experimental Engineering' (Annapolis 1911).

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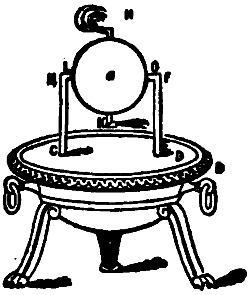
STEAM-ENGINE, the apparatus by means of which the stored heat-energy of fuel, transferred to water and steam, is transformed into mechanical work. This transformation of thermal into dynamic energy, this thermodynamic change, requires for its successful and economical conduct special forms of mechanism and is subject to a variety of wastes of serious aggregate amount, even with the most perfect of modern engines. The series of processes in the train between the fuel and the point of application of the useful energy with statement of the corresponding wastes and efficiencies are as follows: it being understood that an efficiency is the quotient of useful result divided by outgo producing it, the two being expressed in similar terms:— These efficiencies are those of

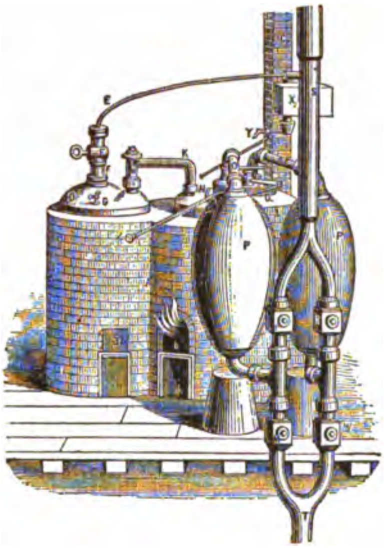
1. Combustion of fuel; ratio of heat set free to total heat latent in the fuel. This efficiency is usually not far from 90 per cent. Wastes due to incomplete combustion.
2. Heat-transfer from furnace to boiler; efficiency as a rule, about 75 per cent, as measured by heat stored in the steam supplied. Wastes occurring mainly at the chimney.
3. Heat-transfer from boiler to engine with loss by conduction and radiation, *en route*. Efficiency of operation about 90 per cent in small boilers and increasing to 95 or 98 per cent in large sizes.
4. Heat-transformation into work at the engine with wastes by defective thermodynamic change and rejection of heat at the lower limit by conduction and radiation within and without the cylinder, variable with size, with mean temperature of steam and other conditions. Efficiencies for the ideal case usually approximate 25 per cent with only thermodynamic wastes, and attain to 20 per cent with successful constructions in the real case; the wastes including the thermodynamic and inevitable losses and the partly controllable extra-thermodynamic wastes.
5. The transfer of mechanical energy from cylinder to point of application. The wastes occur by friction and usually amount to about 10 per cent, as a minimum in condensing, and to 5 per cent in non-condensing engines. Efficiency, 90 to 95 per cent.

The thermodynamic efficiency of the best steam-engines may be thus taken to be 25 per cent; the thermal efficiency at the engine, involving other wastes than thermodynamic, about 20 per cent; the total efficiency between steam-valve and fly-wheel about 18 per cent and the efficiency of engine and boiler combined not far from 14 per cent; while the total efficiency of engine, boiler and furnace, from coal-pile to engine-belt, may be about 12½ per cent. In common constructions these efficiencies are much reduced and in many cases may be divided, by from two to four, the demand for fuel of good quality ranging from about one pound or half a kilogram in the best work to several times that amount per horse-power-hour, and for steam from 10 pounds, about four and a half kilograms, to a multiple of that quantity. In some instances, as with many small boiler feed-pumps, 10 or even 20 times the minimum figure just given are reached, the wastes becoming enormous and the utilized energy of the fuel insignificant.

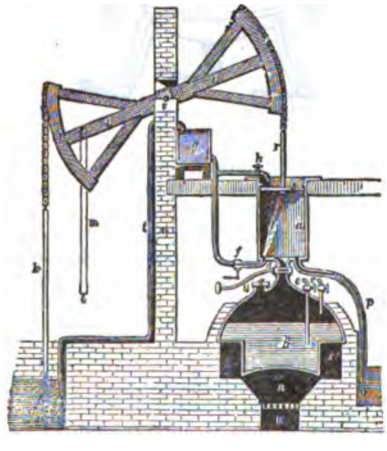


Hero's Steam-turbine (120 B.C.).— A B, steam boiler; C D, supports; *a*, revolving globe; H K, nozzles.

The «ideal case» is understood to be that purely thermodynamic operation which illustrates the conversion of thermal into dynamic energy where no other energies than thermal and dynamic are concerned, and where the change is effected in a machine which is not subject to wastes by conduction or radiation; an apparatus composed of perfectly non-conducting materials and perfectly constructed. In the «real case,» the materials of construction are necessarily good conductors and good radiators of heat, and the wastes by conduction and radiation are often supplemented by leakage of steam as well as of heat. In the real case, the details of construction, adjustment and operation affect very greatly the resultant efficiency and the commercial rating of the engine. The study of the steam-engine thus comprehends the ideal, the purely thermodynamic, case and the real case with its various wastes, thermodynamic and extra-thermodynamic, as well as an investigation of the principles and practice in the design and construction of the real engine.



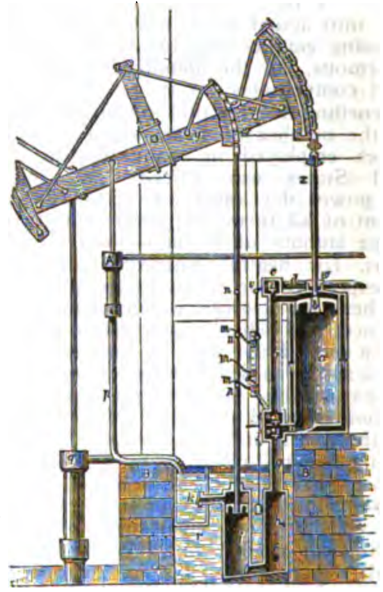
Savery's Engine (1702).— L, boiler; G, feed-vessel; PP, forcing vessels; S, rising main; T, suction.



Newcomen's Engine (1705).—B, boiler; *a*, steam-cylinder; *s r*, piston and rod; K, pump rod.

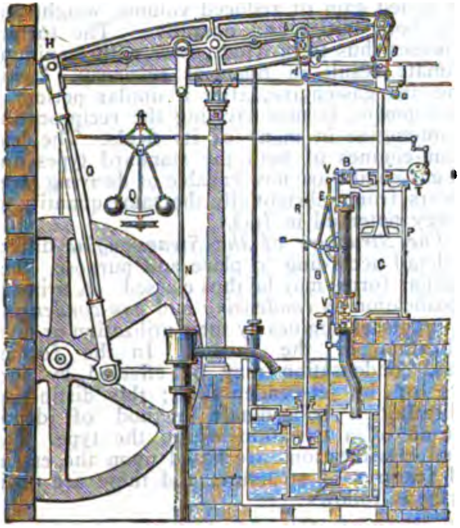
Engines.— The power of steam and the employment of that fluid in various sorts of engines have been familiar to mankind from an unknown and possibly prehistoric period. The earliest known record is that of Hero, who, in his 'Pneumatica' of which the manuscript was produced at Alexandria, about 120 B.C., described a steam-turbine and several forms of steam-fountains and steam-boilers. So far as known, none of them had any useful application and they were simply toys or impracticable schemes. It is unknown, in fact, whether any of them were constructed; although the drawings appear in some cases to be those of actual constructions.

Through the later centuries, up to the 17th, but little progress was made either in the acquirement of a knowledge of the properties of steam or in its application to useful purposes. Some forms of «æolipile,» furnished a steam-jet for improving the draft of the chimney, apparatus for turning the spit and even more ambitious uses were either attempted or suggested; but, until Da Porta's treatise on pneumatics appeared in 1601, in which a steam-fountain was described, and the description in 1629 of an impulse steam-turbine, by Branca, no development took place of any real importance. It was not until the second Marquis of Worcester, Edward Somerset, constructed a steam-fountain (1650) and employed it in raising water from the moat to the top of the tower of Raglan Castle, and later erected another for similar purposes at Vauxhall, that the story of the evolution of the steam-engine really begins. Meantime the scientific men of the later centuries were acquiring some exact knowledge of the nature of steam, earlier confounded with other gases, and some familiarity with its latent powers.



Watt's Engine (1774).— *a*, cylinder; *b*, piston; *x*, rod; *y*, beam; *i j*, air-pump and condenser; *m*, valve-gear.

Steam power first became an acknowledged industrial agent and useful as a prime mover when Savery, at the beginning of the 18th century (1698), made Worcester's steam-fountain practically applicable to the drainage of mines and the elevation of water for water-supply generally. This apparatus, which could not be properly called an engine, consisted of a pair of cylindrical or ellipsoidal «forcing vessels» which were alternately filled with water, by the production of a vacuum within the vessel, and emptied by the introduction of high-pressure steam from an adjacent boiler; the one being emptied while the other was filling and vice-versa, This apparatus, introduced by Savery, improved and further made known by Desaguliers and by Smeaton, was known and in use before the year 1775 throughout the world where mining at considerable depths and in presence of water was carried on. The steam-fountain is still in use and is known as the «pulsometer.»



Watt's Double-acting Engine (1784).— C, cylinder; *b*, beam; O, connecting rod; Q s, governor and valve.

Newcomen's steam-engine, the first steam-engine properly so termed, the first which consisted of a train of mechanism as distinguished from the Hero steam-fountain, which was a piece of apparatus without moving parts, was patented in 1705. It consisted of a steam-cylinder and piston, actuating a beam, above from the opposite end of which was pendant the pump-rod operating the pumps in the shaft of the mine; it was always used as a steam pumping engine. Thomas Newcomen and his partner, John Calley, are thus to be credited with the invention and introduction of the modern steam-engine with all its essential elements as a pumping engine. It was the improvement of this engine by the addition of various valuable devices which gave James Watt his fame and fortune.

This earliest type was a condensing engine in which condensation was effected by means of a jet of water directed into the steam cylinder when the pressure on the under side of the piston was to be removed. The upper side was open to the air, there being no upper cylinder-head. The engine was thus operated by the atmospheric pressure, steam being held at about atmospheric pressure and only employed to secure a vacuum below the piston. The pressure of the atmosphere depressing the piston, the pump-rod on the opposite end of the beam was raised and the pump filled. With the fall of the pump-rod the water was forced out of the pump and raised to the upper level. The weight on the outer end of the beam always overbalanced the weight of the piston and attachments sufficiently to do the required work. This type of engine remained in use for a century, and old engines of Newcomen's time are still in existence. The type became known, later, as the Cornish engine, Watt's improvements having been meantime added. After Newcomen's death, the machine was improved in details by Desaguliers and by Smeaton, who considerably increased its economy by attaching wood to the piston and cylinder-head to prevent what has been called «cylinder condensation» by action of alternately heated and cooled metal in contact with the steam. This was probably the first recognition in construction of this important phenomenon.

The valves of this engine were at first worked by hand; but a boy, Humphrey Potter, is credited with having devised an automatic system, which, later in 1718, carefully designed and constructed in a workmanlike manner by Henry Beighton, a well-known engineer of that period, became the first automatic valve-motion.

James Watt, introducing the needed improvements in the Newcomen engine, finally produced the modern types of «reciprocating» steam-engine. His first great improvement was the separate condenser, which permitted condensation to be effected without the introduction of water into the working cylinder and thus reduced very greatly the waste of steam by initial condensation. Watt first enunciated the principle: «Keep the cylinder, if possible, as hot as the steam that enters it.» The first step was this of removing the primary cause of refrigeration. The next was to surround the cylinder with a chamber containing steam at boiler pressure; thus introducing his second great invention, the «steam-jacket.» He next covered the upper end of the cylinder, excluding the cold air and supplying the place of the atmosphere and its pressure on the upper side of the piston by steam from the boiler, completing his scheme of keeping the cylinder as far as was practicable as hot as the entering steam.

The «double-acting engine» constituted the next and an easy step. With steam admitted at both ends of the cylinder, it was immediately evident that each might be utilized, alternately, in the performance of work and Watt soon adjusted his valve-gear and connections in such manner as to permit this alternation and produce a push and a pull on the piston-rod. This compelled a rigid connection between the piston and overhead beam, on the one end, and between the outer end of the beam and its work, now become that of rotating a shaft with crank and fly-wheel. Thus one improvement led to another and Watt's steam-engine ultimately became capable of supplying power to every imaginable kind of machine or work. The single-acting engine was, for many years after Watt's death, used in raising water and the double-acting engine continues to turn the shaft of mill, locomotive, steamship and factory.

Watt invented and introduced many accessory inventions and devices, as the attachment of the governor — already a well-known apparatus — the steam-engine «indicator,» the expansion of steam, the compound engine, the non-condensing engine, practically all that distinguishes the modern engine from that of Newcomen. These improvements raised the «duty» of the pumping engine, in the course of 25 years, from about 7,000,000 foot-pounds to 30,000,000, and, in the latest forms of Cornish engines, about 1850, to twice the last figure or more, reducing cost of steam-power enormously, and at the same time adapting the steam-engine to every requirement in the industries, giving to the world, in fact, its contemporary civilization. This cost in coal per horse-power-time is reduced from the 35 pounds of Smeaton's time to one pound, as a minimum to-day, and the work of the world is performed by steam-engines, mainly, probably amounting to 150,000,000 horse power and equivalent to the working power of several times the population of the globe, if employed in manual labor.

At the commencement of the 19th century, Trevethick and other able mechanics and inventors were seeking to construct locomotives, and complete success was achieved by George Stephenson in engines built from 1814 to 1833. The steamboat had been suggested by numerous writers and engineers, and, after many attempts, was made a practical success by John Fitch in the United States about 1785, by John Stevens in 1804–09 and commercially by Fulton, 1807–15. In Great Britain, after many early failures, Miller and Symmington and Bell, step by step, attained permanent success and by 1830, the date of the first transatlantic steamship voyages, those of the *Cirius* and the *Great Western,* all civilized countries were employing the steamboat. See STEAM VESSELS.

Meanwhile the elements of economy became recognized and steam-pressures rose from the two to seven pounds above the atmosphere of Watt's time to 25 or 30, about 1850, and to 100 and upward to occasionally 200 at the end of the 19th century; the ratio of expansion of the steam increasing in similar ratio. The speeds of engine-piston also gradually increased from about 100 feet per minute, at the beginning, to 600 and often to 1,000 at its end. The weights of engine and sizes for the usual powers meantime fell from 1,000 pounds or more per horse power developed at the time of Watt, 500 about 1850 and to 250 in 1900 where weights were comparatively unimportant and, in special cases, where weight and volume required to be reduced to the smallest possible figures, as for torpedo-boats, to a fourth or a fifth the last-named quantity.

The compound, the triple and the quadruple expansion engine have largely displaced the simple engine of Watt; the first of these types having been introduced in Watt's time by Hornblower, Woolf and Falk and the second by Kirk about 1874; while the last-mentioned became standard with the rise of steam-pressures to about 15 atmospheres, about 1890. These complications are mainly the outcome of the endeavor to follow Watt in repressing the waste by cylinder condensation, reducing the proportion of heat-absorbing surface and the temperature-head producing flow of heat into the metal of the cylinder. Incidentally, the multiple cylinder engine gives a steadier rotation of the crank-shaft and a smoother action of the steam than the simple engine, and also reduces weight by lessening the maximum load upon the working parts, the range of pressure in each cylinder being reduced with this reduction of temperature-range.

This steady progression from the days of Watt to the present finally culminated in a retrogression to the simple form of the Hero engine, the steam-turbine, in which all the complication of the Watt-Newcomen engine is done away with and but one moving part performs every essential office, apart from condensation, and yet secures, in its best constructions, the economical results of the whole series of changes distinguishing the 19th century, with the added gain of reduced volume, weight and cost, both initial and operative. The turbine promises thus to provide power with maximum ultimate result in financial efficiency. Meantime, the gas-engine, after a similar period of development, is now rivaling the reciprocating steam-engine in many of its fields. The best steam-engines of both the standard types and the gas-engine are now capable of deriving large powers from substantially the same quantity of energy potential in fuel.

The Structure of the Steam-engine differs in detail according to place and purpose. The familiar forms may be thus classed: A primary classification as *condensing* and *non-condensing* distinguishes engines by their utilization or non-utilization of the vacuum. In the former class, condensation may be effected by surface or by jet-condensation; this distinction indicating a subordinate method of identification of a variation within the type. The usual classifications are based upon the essential features of structure, and these are ordinarily as follows:

1. According to the number of cylinders:
    (1) Single cylinder, simple engines.
    (2) Multiple-cylinder engines, "compound," etc.
2. With reference to the construction of cylinders:
    (1) Fixed cylinder.
    (2) Movable cylinder.
    In the first case, the engines are:
        (*a*) Vertical.
        (*b*) Horizontal.
        (*c*) Inclined.
    In the second case, they are:
        (*a*) Oscillating, vibrating, etc.
        (*b*) Rotary, steam-turbines.
3. With reference to the action of the steam:
    (1) Single-acting.
    (2) Double-acting.
4. With reference to the transmission of the steam power:
    (1) Direct-acting.
    (2) Indirect-acting.
    And in the latter case either —
        (*a*) With balance lever, or beam.
        (*b*) Without lever or working beam, geared, etc.

The essential details of these engines are usually the same in all the forms in which the individual piece is found. A rod or a crank, a shaft or a valve, will commonly be found to have assumed a standard form, and the difference in engines is largely a difference in grouping. Since Watt, but few advances have been made in real invention, and the progress observed has been mainly one of refinement and adaptation. Frederick E. Sickels introduced a successful form of «drop cut-off»; Corliss, Greene and others invented improved valve-gears embodying the same general principles, and Potter and Allen, and others, successfully established the «high-speed» engine as a motor where rapid rotation of the prime mover facilitated transmission of power, as with electric generators and in rolling mills.

Similarly, the locomotive proposed by a number of earlier inventors, particularly by Trevethick, who constructed several, was successfully brought into use by George Stephenson and, to-day, in its many forms and uses, the engine in its essential details and distinguishing features is that of Stephenson, refined and adapted to high and to low speeds, to heavy and to light loads. A very noticeable feature of the later engines is the forward "truck" or "bogie," devised by John B. Jervis, which, by permitting the forward wheels to swivel and the engine to rock upon the truck, accommodates the locomotive to sharp curves and irregular track.

In marine construction, a similar adaptation of the form and proportions of the engine to the special purpose in view gives rise to the types employed with side-wheel and screw, high powers and low, to the essential requirements in lightness and small bulk of torpedo-boat practice and the needs of transatlantic navigation and of that of the rivers of the United States. The substitution of surface condensation for condensation by the jet has been compelled in sea-going ships by the use of high-pressure steam and the impracticability of using sea-water in the boilers. The latter forms of engine are thus refinements and adaptations of the earlier.

Meantime, in all directions, the steam-engine has come to be utilized in the production of very large powers, and its construction in very large units is found to be very frequently economically desirable. Stationary engines for mills, and especially for large power-stations supplying the energy applied in electric lighting or power distribution for electric railways, are built in sizes ranging from a few hundred horse power up to 13,000 horse power, and sometimes grouped into systems rating as high as 100,000. Marine engines are also constructed in these large sizes and powers, and as high as 70,000 horse power may be used for the latest and largest transatlantic steamers, as in the *Mauretania*. The locomotive, in the time of Stephenson weighing, in the case of his first successful machines, four to six tons is now built of nearly 120 tons weight and capable of hauling loads of 30,000 tons at good speeds, on level rails. The steam pumping engine of the time of Newcomen and Watt had a capacity of a few hundred thousand gallons per day; it is now furnished in sizes up to 75,000,000 gallons per day for reciprocating engines and up to 320,000,000 for rotary engines, while its duty has risen from the comparatively insignificant figures of the times of the inventors to 150,000,000 and even 180,000,000 foot-pounds per hundred pounds of fuel. The steam-turbine, for all these uses, may now be obtained in as large powers as the reciprocating engine and with substantially the same guaranteed duty. Its relatively high speed of rotation, ranging from 600 to 3,000 in the largest sizes, to 30,000 in the small, and its smooth rotation, make its use distinctively advantageous in electric services and its small weight and volume are peculiarly helpful to the marine engineer and naval constructor.

The Thermodynamics of the Steam-engine, the science of its ideal case, involves the fundamental principles of Energetics and in particular the laws governing the transformation of energy from the form of heat to that of mechanical energy and vice-versa. An all-comprehending law, of which the laws of Energetics are in fact corollaries, the law of Existence, or of whether matter or force or their resultant, energy, and in whatever form, is indestructible by finite power.

Matter may change its form and its chemical composition by rearrangement of its molecules or of its elementary atoms, but it cannot be destroyed; forces inhere and are persistent as characteristics of all matter and cannot be separated therefrom; energy, like matter, is constant in its total quantity in the universe and may be transferred and transformed, but cannot be extinguished. Transformation of energy, as of thermal into dynamic or mechanical, is simply the change of the kind of mass affected and consequent alteration of the kind of motion due to its action. A shot from a gun, stopped in its rapid flight by impact on the target, if not fractured, will exchange the thousands of foot-tons of mechanical energy sustaining its flight for precisely the same quantity of molecular motion and energy. Similarly, were a shot heated to a high temperature and then were all its molecules by some conceivable process of steering each into its path, made to take up simultaneously a definite rectilinear motion, it would become absolutely cold and would fly out into space with a dynamic mass-energy precisely equal and, in fact, with the identical energy at first displayed as molecular. The heat-engine is a device for bringing about such a change for industrial purposes.

The laws of energetics, as usually enunciated, are:

1. *The Law of Persistence, or of Conservation of Energy*, namely: Existing energy can never be annihilated; and the total energy, actual and potential, of any isolated system can never change.

This is evidently a corollary of that grander law, asserting the indestructibility of all the work of creation, which has already been enunciated.

2. *The Law of Dissipation, or of Degradation of Energy*, namely: All energy tends to diffuse itself throughout space, with a continual loss of intensity, with what seems, now, to be the inevitable result of complete and uniform dispersion throughout the universe, and consequently of entire loss of availability.

It is only by differences in the intensity of energy, and the consequent tendency to forcible dispersion, that it is possible to make it available in the production of work.

3. *The Law of Transformation of Energy*, namely: Energy may be transformed from one condition to another, or from any one kind or state to any other; changing from mass-energy to molecular energy of any kind, or from one form of molecular energy to another, with a definite quantivalence.

Thermodynamics, being a restricted energetic, in which only two energies, thermal and dynamic, are comprehended, its laws are, fundamentally, identical with the preceding and the enunciation just adopted is entirely accurate in this restricted science.

The Laws of Thermodynamics, in the special forms considered best for the purposes of the thermodynamist, are corollaries of the laws of energetics and of Newton's laws, which are a different method of expression of the same fundamental principles. They are usually stated thus:

1. *Thermal and Mechanical Energy are mutually interconvertible in the proportion of one British Thermal Unit for each 778 foot-pounds, or of one calorie for each 427 kilogrammetres of energy or of work.*

The mechanical equivalent of heat is the specific heat of water at its temperature of maximum density expressed in dynamic units, as foot-pounds or kilogrammetres.

The value of the mechanical equivalent of heat has been taken as first adopted by Joule, although recent and most carefully conducted investigations indicate a value higher by perhaps 1 per cent, to be more accurate. Many existing tables, and much work done in this field to date, have, however, been based upon Joule's figure, 772 foot-pounds, 423 kilogrammetres. The figure, above given, 778 or 427, is now, however, generally accepted.

2. *The total of any single effect of any given quantity of heat acting in any thermodynamic operation is proportional to the total amount of heat-energy so acting.*

This principle is substantially that first accepted by Rankine as the second law. Actually energy of vibration is understood.

Thus, of the whole quantity of heat passing from the heater to the working substance, one part is always transmuted into mechanical work, or energy; while the remainder goes to the refrigerator, and the ratio of the one quantity to the other is perfectly definite.

Professor Wood expresses this law thus:

" If all the heat absorbed be at one temperature, and that rejected be at one lower temperature, then will the heat which is transmuted into work be to the entire heat absorbed in the same ratio as the difference between the absolute temperatures of source and refrigerator is to the absolute temperature of the source."

The second law finds important application simply in enabling us to ascertain the total quantity of work, external and internal, required to produce changes of volume and energy in fluids, like the vapors, in which we cannot measure directly the internal forces and internal work.

If the change of sensible heat be called dS, that of " latent " heat, dL, and of external work, dU, then the first law of thermodynamics is expressed by the equations:

$$dH = dS + dL + dU, \quad \ldots \ldots \quad (A)$$

and

$$dH = dS + dW, \quad \ldots \ldots \quad (B)$$

$$dH = dE + dU, \quad \ldots \ldots \quad (C)$$

where, in the last two expressions, $dE = dS + dL$, and is the variation of energy, actual and potential; while $dW = dL + dU$, and is the total work done, externally and internally. These are primary and general equations.

The quantity E is often called the intrinsic energy of the substance; L is evidently a potential energy; while S is a form of molecular kinetic, or actual, energy, which may sometimes be regarded as also in a sense potential.

The above are completely general expressions of the *general fundamental equation of thermodynamics.*

Internal work or energy, positive or negative, is the work performed in changing the relative distances between molecules, atoms or corpuscles, or in causing variation of their relative velocities, and within the mass and out of reach of the human senses. In the fundamental equation, it is measured by dL.

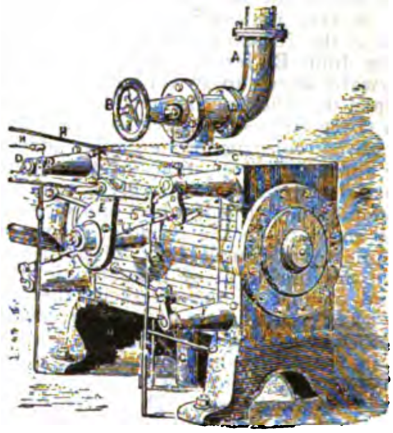
External work is that performed by mass or molecule, by atom or corpuscle against outside resistances, as where steam expands, doing work upon a piston. As indicated by the above laws, it must do so by surrendering an equivalent quantity of heat-energy. This is dW.

Heat-energy, thermal or dynamic, is of the same nature and may be measured in either thermal or dynamic units, foot-pounds and kilogrammetres, or in British or metric thermal units or «calories.» One *B. T. U.,* expressed in thermal units, is 778 foot-pounds expressed in dynamic units; one metric unit, the calorie, is 3.96832 times as great as the British, or the *B. T. U.* is 0.251996 of the metric unit. The engineer often conducts his thermodynamic investigations in dynamic terms; the physicist and the chemist employ the thermal; the one often uses British, the other always adopts the metric. Where work is performed by an expanding fluid upon a moving piston, the total work,

$$U = (p_e + p_i)as;$$

where a is the piston-area, and s is the space traversed by the piston; mean pressures corresponding to the external and the internal work being p_e and p_i while $as = v$, the volume traversed.

The Perfect Gas is a fluid within which no internal work is done with varying volumes and which may be defined by the equations, $pv = aT$; $pv/T = a$. In thermodynamic equations, the perfect gas has zero values of internal energy and work. T is absolute temperature, p and v the pressures and volumes at that temperature of unit mass.



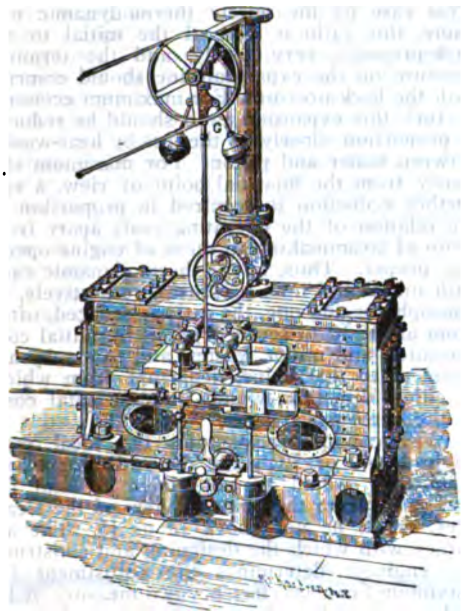
Corliss Engine Valve-motion (1850).

Vapors are fluids in which the internal energy and work may be large, both absolutely and relatively, with changing volumes. Internal cohesive forces are often not only sensible but very great, the internal latent heat, which simply measures the internal work when expanding water into vapor of one atmosphere pressure, as an example, is the equipment of the work of elevation of the weight affected to a height of about 150 miles. These forces, however, as with the gases, do not prevent the free movement of molecules in any direction and to any extent; nor do they fix the volume and density of the substance.

Liquids are fluids in which the action of internal molecular forces gives stability of volume, but not of form, and the energies, internal and external, are thus limited to comparatively small ranges and to comparatively small values; while range and values are often enormously great when the liquid becomes vaporous, notwithstanding rapid diminution of molecular attractions.

Solids have stability, both of volume and of form; the ranges of internal forces and of energies are still more restricted than with liquids and their extent of action and their values are still less than in liquids. By accession of heat, all solids become at some definite point liquid, liquids become vapors and vapors, when «superheated,» become gases. It is to be noted that, whenever a substance, of whatever class, alternately expands and contracts through a fixed range of volume, whatever its temperature or the pressure, precisely the same amount of internal energy is lost and gained by variation of volume against or with the constant effort of the internal forces.

Cycle is, thermodynamically, an operation in which a working substance passes through a series of changes of pressure, volume and temperature resulting in the final return of the substance to its initial physical state. In this operation, it is evident that the net change of internal energy is zero. This process is illustrated in heat-engines in which the working substance is confined within the working chamber and therein passes through repeated cycles with repetition of the kinematic cycle of the machine itself. Obviously, also, where a working fluid traverses a cycle, the presence or the absence of the quantity of internal energy becomes a matter of no importance when we seek only to determine the quantity of permanent thermodynamic transformation. The magnitude and effect of internal forces and energies have no influence upon the efficiency of transformation; but they have importance as affecting the relations of pressure, volume and temperature and the magnitude of the working cylinder and of the heat-engine itself. In the highest boiler pressures now usual, these forces are about 10 times the gauge pressure. At atmospheric external pressure, they amount to 13 atmospheres. These pressures cannot be measured by any gauge, but may be readily computed with precision from easily ascertainable data; they are perfectly well known, as are the specific volumes of the fluid, which are very difficult, but not impossible, of direct measurement.



Greene Engine (1855).

The gas-engine has the advantage in comparison with the steam-engine, in its higher available temperature range and consequent higher thermodynamic efficiency.

The exact treatment of the thermodynamics of the steam-engine requires the use of the higher mathematics, but the general principles have been given and the following will permit its applications to be understood:

A steam-engine is a thermodynamic system in which only thermal and dynamic energies are present and operative. Its action is to transform as large a proportion as possible of the heat supplied it into mechanical power and work. Each pound of steam from the boiler usually brings over the equivalent of about 0.4 horse-power-hour and each horse-power-hour is the ideal equivalent of the heat-content of about 2.3 pounds, a kilogram, nearly, of boiler steam. Of this heat, a part, which is precisely measured by the area of the indicator diagram, is converted into useful work and an «efficiency» is attained measured by the ratio of the useful to the supplied energy in common units. Thus: where 23 pounds of steam per hour are demanded per horse power developed, in the case assumed, the efficiency is 10 per cent; the heat supplied being that furnished from the fuel and measured by the difference between the «total heat» of the feed-water at condenser temperature and that of the steam in the boiler.

The nine-tenths which fails of utilization is composed of a variety of wastes, including the thermodynamic, that portion of the heat reaching the steam-cylinder and actually acting upon the piston which is not converted into indicated work, the waste by conduction and radiation externally and the waste by the transfer of heat between the metal of the cylinder and the working fluid. These quantities in a good example may be taken as follows, the friction wastes of the machine itself being included:

Available heat-energy from the boiler............100	Thermodynamic wastes..	70
	Internal thermal loss.....	10
	External waste..........	5
	Friction.................	2
	Useful work.............	13
		100

This corresponds, for the ideal case, to an efficiency of 0.20, nearly.

The external waste of the steam-engine is usually considered to be covered by an allowance of about one *B. T. U.* per square foot per hour per degree range of temperature, Fahrenheit, or about three calories per square metre, although, on exposed metal having a rough surface, it may attain two to three times these figures. The exterior of the cylinder is commonly lagged and the heads, if not thus covered, are polished, thus minimizing the waste. The total waste, on even small engines, has been found capable of being reduced to less than 3.5 per cent, total, inclusive of engine and boiler, by the use of good non-conducting coverings. This loss is often quite unimportant on large engines.

The internal wastes are produced by heat-exchanges between metal and steam, at induction and eduction; the steam giving heat to the metal at its entrance into the cylinder and robbing the metal at exhaust, thus transferring heat often in large quantities from the steam to the exhaust side, very much as leakage carries the steam itself with its charge of heat. The effect on efficiency is precisely that of leakage. In this action, the cylinder-heads and the sides of the piston, being exposed to the widest range of temperature and for the longest periods, are most fruitful of waste; the cylinder, proper, and especially its middle portion, wastes least. The total loss is a function of the temperature range, the time of exposure to transfer, and the quality of steam, and of the ratio of expansion which measures rudely the quantity of steam per unit weight of metal. In any one engine it may be stated, as a rough approximation, that the condensation is a constant quantity at all expansions. It may be treated as either a constant leakage or as a constant loss of work measurable by an equivalent back-pressure. A common value of this leakage may be taken, in pounds, as not far from 0.02 *B. T. U.*, per square foot of surface exposed at cut-off, per minute per Fahrenheit degree of temperature-range. As a fraction of the steam supplied, it is approximately proportional in any given engine to the square root of the ratio of expansion. With various types of engine, it ranges from 25 or 30 per cent, with simple engines of moderate size to 10 per cent, in multiple-cylinder engines of modern construction as a minimum. In steam pumps and very small engines, it may amount to more than the whole amount of steam taken in, for thermodynamic action. These machines, demanding 100, and even sometimes 150 or more pounds of steam per horse power hour, waste three-fourths or more by «leakage» of heat. The «record-breaking» engines of large size and superior design demand as little as 10 to 12 pounds, approximating 200 *B. T. U.* per horse power hour.

The velocity of heat-exchange in this manner is many times greater than in transfers across the boiler heating surfaces. It is the most rapid known form of condensation of steam, and is often 10 times as rapid as the production of steam in the boiler supplying it.

The conditions of maximum efficiency are mainly two: the reduction to the practicable minimum of the thermodynamic waste by increasing in all possible ways the area of the indicator diagram per unit of steam supplied, and by minimizing the wastes of heat between boiler and engine-piston. The first includes the increase of the initial pressure, with decrease of back-pressure and adjustment of the ratio of expansion of the steam to the range thus secured; the second involves reduction of conduction and radiation by use of suitable non-conducting coverings of heated surfaces, protection from cooling influences and reducing «cylinder condensation» by drying and superheating the steam, by increasing the speed of engine and by diminishing the heat-exchanges between metal and steam by fine finish of surfaces, and, where practicable, by interposition of non-conducting material, as was done by Smeaton and attempted by later inventors.

«Mechanical efficiency,» the ratio of work transmitted from the piston to the point of useful application, ranges from 95 per cent in direct-acting engines as a maximum, to 85 per cent with the older non-condensing engines. It is made a maximum and friction reduced to a minimum by careful design, and especially by securing constant, complete and free lubrication; usually, in the best cases, by a circulatory flow of oil, flooding the bearings and returned by pumps to the source, through a filter, to be again distributed to the rubbing surfaces of the engine. The lost work is the less, as the pressures are higher within limits determined by the nature of the materials, as the lubricant is better adapted to its intended purpose, and as the flow is more liberal where reaching the rubbing parts. The highest values of the coefficient of friction are often 10 and sometimes 20 times the lowest and the careful attention of the engineer to this detail is always well compensated.

The ultimate limit of economy in operation, with any class of engine, is fixed by financial considerations, and the principle involved in determining the limit may be thus expressed:

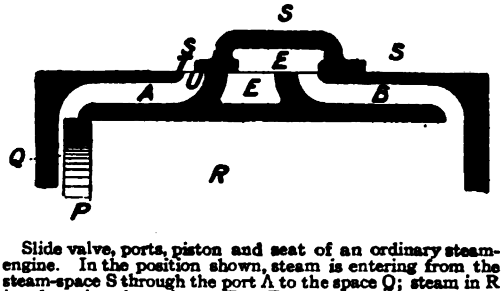
That engine is most perfectly adapted to its place and purpose of which the type is such that no practicable substitution will permit the supply of the demanded power at lower total operative costs, including interest on first cost, a sinking fund to provide for replacement at the end of its period of use and annual operating expense; and that size of engine is on the whole best, variation from which in the direction of either increased or lessened size will increase that total expense of operation. In the latter case, the gain by reduction of size will be more than compensated by the loss due to its reduced efficiency. The best engine is that which will give largest returns on the capital invested, adding most effectively during its life to the dividends obtainable from the «plant» of which it forms a part.

The adjustment of the ratio of expansion of the steam to the requirements of maximum efficiency is the vital problem of the designing engineer and the purchaser of the engine. In the ideal case of the purely thermodynamic machine, this ratio is that of the initial to the back-pressure, very nearly, and the terminal pressure on the expansion-line should coincide with the back-pressure. For maximum economy of fuel, this expansion ratio should be reduced in proportion, closely, to the loss by heat-wastes between boiler and piston. For maximum efficiency from the financial point of view, a still further reduction is required in proportion to the relation of the operating costs apart from those of steammaking to those of engine-operation proper. Thus, in the thermodynamic case, with initial and final pressures, respectively, 10 atmospheres and one, the ratio is reduced, often from about 10 to seven or eight by initial condensation and minor wastes, and to six by adjustment to that value, departure from which, in either direction, would increase total costs of the horse-power-hour.

With condensing engines, the ideal ratio might be 40 or 50, while the ratio for maximum duty would be not above 20, and the best ratio, from the point of view of the treasurer, might be not above 12 or 15. The accuracy with which the designing and constructing engineer determines the adjustment for maximum financial efficiency is a measure of his ability and skill and a gauge of his success in solving his problem. With each standard construction, experience usually enables the engineer to satisfactorily determine the proper solution of this problem.

The case of the steam-turbine exhibits here one of its essential peculiarities. The ratio of expansion is fixed by the conditions of its design, construction and operation and is necessarily the ratio of initial to back-pressure if properly constructed. The maximum efficiency of the turbine is obtained at its maximum power and it possesses the same inherent inflexibility as the hydraulic turbine, if of other than the «partial» class, in which latter case power is adjusted to load by varying the number of nozzles or supply-passages in action. It has the same possibilities of adaptation as has the hydraulic with, further, available recourse to intermittent supply, as with the Parsons turbine, a plan unavailable with the hydraulic machine, as an element of regulation. The steam-turbine, also, is not subject to internal condensation as all its elements, when in steady operation, maintain a constant temperature. Its economic theory is thus greatly simplified. Its financial theory simply dictates the construction of a light, rapidly moving vane and a minimum cost of application to its work, to operation and to maintenance, as a total.

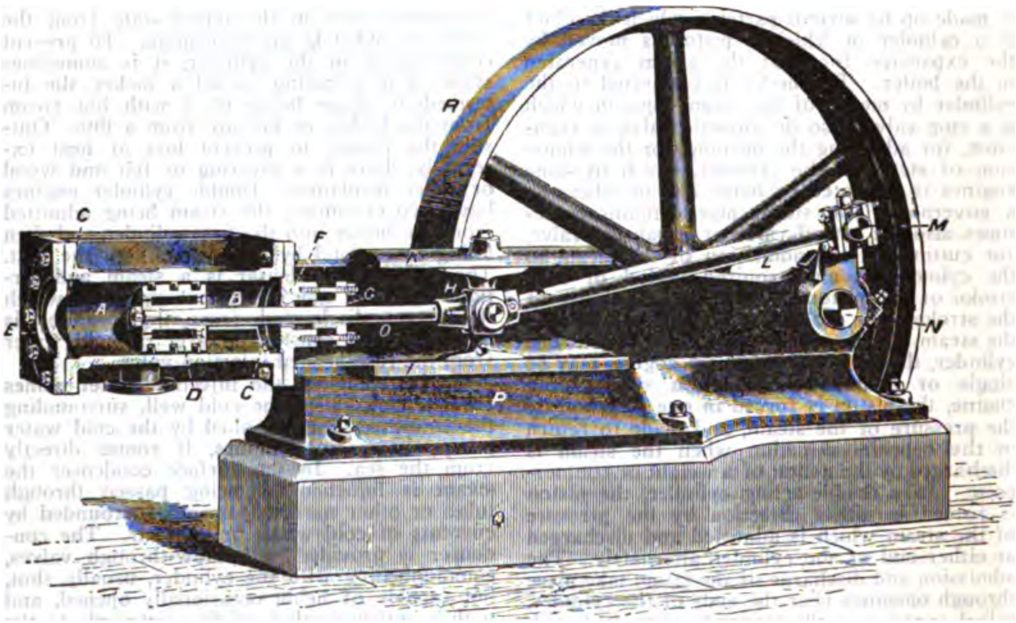
Essential Parts of the Steam-Engine.— The steam-engine consists necessarily of two parts — the engine proper, in which the expansive force of steam is expended and the generator or boiler, in which the energy derived from a burning fuel is transferred to water. (The steam generator or boiler is fully dealt with in the article BOILER). The engine proper is made up of several parts of which the chief is a cylinder in which a piston is moved by the expansive force of the steam generated in the boiler. The boiler is connected to the cylinder by means of the steam pipe, in which is a stop valve, also the throttle valve or regulator, for adjusting the opening for the admission of steam to the cylinder, which in some engines is regulated by hand, and in others by a governor. The steam pipe contains sometimes also the cut-off valve or expansion valve, for cutting off the admission of the steam to the cylinder at any required period of each stroke of the piston, leaving the remainder of the stroke to be performed by the expansion of the steam already admitted to the cylinder. The cylinder, the heart of the steam engine, may be single or double acting. In a single-acting engine, the piston is forced in one direction by the pressure of the steam, and made to return in the opposite direction when the steam is discharged by the action of a weight or counterpoise. In a double-acting cylinder, the piston is forced in either direction by the pressure of the steam which is admitted and discharged at either end of the cylinder alternately. The admission and discharge of the steam take place through openings near the ends of the cylinder, called ports (see illustration), connected with passages called nozzles, which are opened and closed by induction and eduction valves. Sometimes the induction and eduction valves are combined in one valve, called a slide valve. The valves are contained in the valve chest. In non-condensing engines (conventionally called high pressure engines), the waste steam discharged from the cylinder escapes into the atmosphere through the blast pipe; in locomotive engines, as well as some others, the blast pipe is placed in the centre of the chimney, so that the successive blasts of steam discharged from it augment the draught of air through the furnace, and cause the combustion of the fuel to be more or less rapid, according as the engine is performing more or less work. The cylinder cover has in it a stuffing box for the passage of the piston rod; in large engines there are sometimes more than one piston rod and stuffing box, and sometimes a tubular piston rod, called a trunk. The cylinder cover is also provided with a grease cup to facilitate the lubrication of the cylinder and piston rod. In many large engines, there is a spring safety valve, called an escape valve, at each end of the cylinder; the chief use of which is to discharge water which may condense in the cylinder, or be carried over in the liquid state from the boiler, by what is called priming. To prevent condensation in the cylinder, it is sometimes enclosed in a casing, called a jacket, the intermediate space being filled with hot steam from the boiler, or hot air from a flue. Outside the jacket, to prevent loss of heat externally, there is a covering of felt and wood or other insulation. Double cylinder engines have two cylinders; the steam being admitted from the boiler into the first cylinder and then filling the second by expansion from the first. The ordinary condenser is a steam and air-tight vessel of any convenient shape, in which the steam discharged from the cylinder is liquefied by a constant shower of cold water from the rose-headed injection valve.



Slide valve, ports, piston and seat of an ordinary steam-engine. In the position shown, steam is entering from the steam-space S through the port A to the space Q; steam in R is exhausting through port B to E.

In land engines the injection water comes from a tank called the cold well, surrounding the condenser, and supplied by the cold water pump; in marine engines, it comes directly from the sea. In the surface condenser the steam is liquefied by being passed through tubes or other narrow passages surrounded by currents of cold water or cold air. The condenser is provided with blow-through valves, communicating with the cylinder, usually shut, but capable of being occasionally opened, and with a snifting valve opening outwards to the atmosphere; through these valves steam can be blown to expel air from the cylinder and condenser before the engine is set to work. The condenser has also a vacuum gauge, to show how much the pressure in it falls below that of the atmosphere. The water, the small portion of steam which remains uncondensed, and the air which may be mixed with it, are sucked from the condenser by the air pump, and discharged into the hot well, a tank from which the feed pump draws the supply of water from the boiler. The surplus water of the hot well in land engines is discharged into a tank there to cool and form a store for the cold well; in marine engines, it is ejected into the sea.

In all, except certain peculiar classes of engines, there is a parallel motion for guiding the head of the piston rod to move in a straight line, consisting either simply of straight cheeks or guides, or of a combination of levers and linkwork, invented by Watt, and more or less modified by others. The special classes of engines above referred to are — first, trunk engines, where the stuffing box is the guide; secondly, oscillating engines, in which the head of the piston rod is directly connected with the crank, and the cylinder oscillates on trunnions; thirdly, disc engines in which the functions of a cylinder are performed by a vessel of the figure of a spherical zone and those of a piston by a disc having a motion in that zone, and fourthly, rotary engines, in which the piston revolves round an axis. In single-acting engines for pumping water, the pump rods are worked either by direct connection with the piston rod, or through the intervention of a beam. In double-acting engines, the power is communicated to a revolving shaft, driven by means of a crank and connecting rod, with or without the intervention of a beam. In stationary engines the shaft carries a fly-wheel, to distribute and equalize irregularities in the action of the power by its inertia; this function is performed in marine engines by the inertia of the paddle wheels or screw, and, in locomotive engines, by the inertia of the driving wheels and of the engine itself. The feed pump, and other pumps which are appendages of the engine, are worked by the mechanism; so also are the induction and eduction valves, through what is called the valve gearing or valve motion — a part of the machinery which is under the control of the engineman, and so contrived as to enable him to stop and reverse the motion of the engines at will, and whose forms are very various. Most marine and locomotive engines, and many stationary engines, have, in order to equalize the action of the power, a pair of cranks at right angles to each other, driven by a pair of pistons in a pair of cylinders, with their appendages.



HORIZONTAL STEAM ENGINE.

A B cast-iron cylinder closed at ends by castings E and F. This engine has no steam jacket, and the lagging of felt and wood which is used to diminish radiation and condensation is not shown. There are two flat openings or ports at the ends C C, through which steam may be admitted and exhausted. Valve motion is not shown. The piston D is fitted with three packing rings to make it steam-tight. G O piston rod packing. H knuckle of connecting rod L. M crank. N main shaft. R fly-wheel.

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ING OF; LOCOMOTIVE; ROTARY STEAM ENGINE; STEAM VESSELS; TRACTION ENGINES; TURBINE.

STEAM ENGINEERING, Bureau of, a bureau of the United States Department of the Navy, established by act of Congress, 5 July 1862. Its duties as defined by the navy regulations comprise «all that relates to the designing, building, fitting out and repairing machinery used for the propulsion of naval vessels, the steam pumps, steam heaters, distilling apparatus, refrigerating apparatus, all steam connections of ships and the steam machinery necessary for actuating the apparatus by which turrets are turned.» The engineer-in-chief of the navy is chief of the bureau. Rear Admiral R. S. Griffin was its chief in 1918.

STEAM GAUGE. See STEAM; STEAM-ENGINE.

STEAM HAMMER. See HAMMER.

STEAM HEATING. See HEATING AND VENTILATION.

STEAM JACKET, a space filled with steam surrounding the cylinder of a steam-engine; from it heat passes into the cylinder and prevents the condensation of steam which would otherwise take place during expansion.

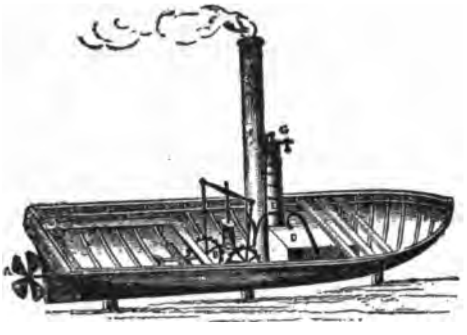
STEAM NAVIGATION. See STEAM VESSELS.

STEAM-TURBINE. See STEAM-ENGINE; TURBINE.

STEAM VEHICLES or STEAM CARRIAGES, as the name implies, are carriages or conveyances in which steam is used as the motive power. The name is now usually applied to those vehicles which preceded the steam locomotive on rails and were designed for use on the ordinary highways. In 1824 David Gordon patented an arrangement for fitting to a steam-engine a set of jointed legs in imitation of the action of a horse's feet. In the same year Burstall and Hill made a steam-carriage in which the engine was like Evans', except that its cylinder was at the end of the beam and the connecting-rod in the middle. Earlier efforts to construct a steam-vehicle were made by Robinson and by Watt in 1759 and by Cugnot 10 years later, but it was not until the third decade of the 19th century that the steam-engine had been sufficiently developed to tempt inventors to try to adapt it to road service. In 1827 Gurney built a steam-carriage which worked for about two years in and around London, one of its trips covering 85 miles in 10 hours, including all stops. In 1828 he built a steam-carriage having a sectional boiler. Its cylinders were horizontal and the valve-gearing was driven by an eccentric on the rear axle. The link was moved by a cord running from the driver's seat. There was a separator to dry the steam, a forced draught and a feed-heater; and the valve cut off the steam at about one-half stroke. In 1829 Anderson and James built a road-engine which weighed three tons and carried 15 passengers on a rough graveled road at from 12 to 15 miles per hour. The same year Hancock built a road-engine with a boiler consisting of a collection of flat chambers with boiler-plate sides, the chambers being connected by tubes and stays. In 1831 he placed a steam-carriage on the road between London and Stratford, where it ran regularly; while at the same time Dance had one running between Cheltenham and Gloucester, where it ran back and forth 3,500 miles, running nine miles, the distance between the two places, in 55 minutes and meeting with but one mishap, which was the result of malice. Ogle and Summer's steam-carriage ran from 32 to 35 miles an hour, carrying 250 pounds of steam. Hancock's *Infant* of 1831 ran from Brighton to London, carrying a party of 11, at from nine to 15 miles an hour. Hancock's *Autopsy* of 1833 went about the streets of London at all times without difficulty. By this time there were about 20 steam-carriages and traction-road engines running in England, where good roads had aided the inventors and builders; but hostile legislation checked the advance of this method of conveyance. Moreover the life of a steam-vehicle was very short, due to excessive vibration. No steam-carriage, steam-omnibus, street-locomotive or traction engine became a serious competitor to the horse carriage throughout the 19th century and in the closing years of the latter the automobile arrived, fitted with an internal combustion engine and pneumatic tires which eliminated all excessive vibration and the doom of the steam-vehicle was finally sealed.

STEAM VESSELS. The paddle wheel was in use for the propulsion of a vessel long before the application of steam to navigation. In the war galleys of the ancient Egyptians and Romans there were wheels operated by hand power through a windlass; and in one of the Punic wars the Romans transferred an army to Sicily upon vessels moved by wheels that were operated by oxen. Prince Rupert, after retiring from his military life, had a boat constructed on the Thames River, prior to 1680, that was propelled by paddle wheels, which were driven by horse power. It is thus clear that some form of paddle wheel for propulsion was made use of long before the steam-engine was in service. The Marquis of Worcester had experimented with the steam-engine from about 1655. He died in 1667 leaving a manuscript in which he says: «By this I can make a vessel of as great burthen as the river can bear to go against the stream. . . . And this engine is applicable to any vessel or boat whatsoever, without, therefore, being made on purpose. . . . It roweth, it draweth, it driveth, to pass London Bridge, against the stream at low water.»

Early Steamboats.— The experiment narrated many years ago of Blasco de Garay in 1543 at Barcelona moving a vessel by steam power has long since been looked upon with doubt. This was 100 years before the steam-engine was put to any practical use even in its crude form. Denis Papin and Thomas Savery had proposed the application of steam to navigation about 1690, and the former is said to have applied it on a model at a later date. The name of Newcomen is also intimately associated with these earliest experiments and he is doubtless to be credited with having built the steam-engines used. In 1736 Jonathan Hulls of England obtained a patent upon what would be termed a stern wheel boat for towing purposes. The engine for this boat was made by Newcomen, and the vessel was tested on the Avon but without enough success to attract needed capital, and no further efforts were made. Experiments were made in France from 1779 to 1783 by Genevois and Perrier, when the Marquis de Jouffroy built on the river Saône a steamboat of 150 feet long by 15 feet wide, which continued running with more or less success for 16 months, but defects developed in the machinery so serious as to cause the project to be abandoned for lack of money. Jouffroy proposed a company to build and operate steamboats, but failed to gain support. He has, however, been credited in history as the true inventor of the steamboat. Patrick Miller, a wealthy retired banker of Scotland, in 1788 had a double hull boat constructed 25 feet long and seven feet broad, and fitted with a steam-engine, under the supervision of William Symington. It succeeded so well that he built the next year a larger double hull boat, and a trial was made on the Forth and Clyde Canal in the summer of 1789, when seven miles an hour was made. The boat, the wheels and the engine were so ill proportioned to each other that the wheels were continually breaking, and the hull suffered so much from the strain imparted by the machinery as to be in danger of sinking. The trial was not considered to be a success, and the vessel was shortly after laid aside. It was now over 10 years before any further trials were made in Great Britain. It will be noted that John Fitch's experiments began in 1786, and Patrick Miller did not begin until some two years later. Symington had not lost faith in the project, and succeeded finally in interesting Lord Dundas, one of the proprietors of the Forth and Clyde Canal, in steam propulsion for canals, and with his support in 1801 built the *Charlotte Dundas*, a stern wheel boat to tow the canal boats on the canal, instead of towing with horses. The vessel was 56 feet long, 18 feet beam and 8 feet in depth and was fitted with an engine of 22 inches cylinder by four feet stroke. The trial was made in March 1802 with two boats in tow, and three and one-half miles per hour was made for a distance of nearly 20 miles. A great clamor arose as to the probable destruction of the banks of the canal from the violent agitation of the water produced by the paddle wheel, and the project was abandoned. A further effort by Symington, under the patronage of the Duke of Bridgewater, came to an end with the death of the duke and Symington, reduced to poverty, withdrew from further endeavor. It was now 10 years before another steam vessel was built in Great Britain, and in the meantime Livingston and Fulton had constructed four steamboats for the Hudson River, and the *Raritan* for the New Jersey line, and the *New Orleans* for the Western rivers; while John Stevens had built the *Phœnix* and sent her to sea from New York to Philadelphia, Pa. This vessel was built in 1812 at Glasgow by John Wood for Henry Bell, and was the first successful steam vessel in Great Britain. The hull was 42 feet long by 11 feet beam and five feet six inches deep, and named *Comet*. By means of spur wheel gearing the power was transmitted to two pairs of paddles. As this arrangement proved to be unsatisfactory the vessel was fitted with a single pair of wheels, and the hull was lengthened to 60 feet, and the engine power increased. The speed of this vessel was originally five miles per hour. Robertson, the engineer of the *Comet*, succeeded in so improving her engines as to raise the speed to six miles per hour. His success led him into steamboat building on his own account, and in 1813 he started the *Clyde*, and in 1814, the *Tay*, *Caledonia* and *Humber*, all of which proved commercially profitable. The first iron hull steam vessel built in Great Britain was in 1822 named the *Aaron Manby*, built at the Horsley Iron Works near Birmingham. The vessel was 166 feet long and 16 feet beam, and fitted with a 30 horse-power engine operating «Oldham's Revolving Oars that enter and leave the water edgewise.»


Stevens' Screw Steamer (1804)

First American Steam Vessels.— The period when the first experiment with a steam vessel in the United States was made, so far as the mechanical side was concerned, was anything but inviting to those interested. There was not in the United States at the time one steam-engine in use, and it is doubtful if the first principles of its working were understood. The American people were comparatively poor at this time, having but a few years prior to this date returned to the peaceful pursuits of life after the long and costly War of the Revolution. After a few years the «steam mania» broke out, and the application of steam to navigation was under trial. To John Fitch of Connecticut must be given the credit for the first steamboat in the United States, imperfect as it was. He made his first trial on 22 Aug. 1787, but was not able to attain more than three miles an hour. This boat was propelled «by 12 oars or paddles five and a half feet, which work perpendicularly and are represented by the stroke of the paddle of a canoe.» Then in 1789 another boat was built that was fitted with more power, that developed on trial a rate of speed of eight miles an hour. These experiments were carried on by a company who furnished the capital for the enterprise, and not meeting with the success anticipated after three years' labor, refused to advance any more funds for the further prosecution of the enterprise, thus leaving Fitch to carry on his trials on his own account. This he did for a short time only, as he was unable to procure the means for the necessary changes in the vessel, and it was this financial condition that finally forced him to abandon the whole business, and he went to France and England with his drawings, but met with no better fortune. Upon his return in 1796 he made an experiment on the Collect Pond in New York in a common yawl boat, with both side wheels, and again with a propeller at the stern of the boat. Nothing seems to have come from these later experiments. Fitch has been described as having been brought up from manhood as a watchmaker, and being fond of mechanics through the prosecution of his trade, he was continually experimenting along different lines, and at last drifted into the application of steam to navigation. He no doubt had a small knowledge of the steam-engine, but his peculiar disposition, ever urged on by his impulses, subjected him to many disappointments. There is no doubt he accomplished more in propelling his boats than some others have done at a later date. James Rumsay, a native of Maryland, and a strong competitor in the experimental stage of steam navigation with John Fitch, constructed in 1784 a boat that was propelled by cranks and a series of "setting poles." This project was soon abandoned. In 1787 he constructed a boat about 50 feet long, that was propelled by admitting water through a trunk on the keelson of the vessel, and by means of a steam pump discharging it at the stern. This boat was never put to any practical use. Leaving the United States to his opponent, Rumsay sailed for London, where he built another vessel, but he died in 1793, following a successful exhibit of his craft. Another name connected with the earliest experiments with steamboats in America is that of Samuel Morey, who in 1790 ran a small boat with a paddle wheel at the bow on the Connecticut River, and in 1797 operated a side-wheel steamboat on the Delaware River. To Oliver Evans, an engine builder of Pennsylvania, must be given some credit for his trials in steam navigation. In 1802 he was called on to construct an engine of nine inches cylinder by 36 inches stroke, for a boat of 80 feet long and 18 feet beam, built in Kentucky for Capt. James McKeever, United States navy, and Louis Valcourt, and floated to New Orleans, La. Before the vessel was completed the river had fallen so much as to leave the vessel high and dry on shore. The engine and boiler were taken out and placed in a saw-mill, where they were in use until the mill was destroyed by fire. In 1804 he constructed for the city of Philadelphia a machine for dredging the slips of the city. The machinery was fitted in place on a large scow 30 feet long by 12 feet beam, and was driven by a stern wheel that was operated by a small steam-engine. It was driven down the Schuylkill River to the Delaware River, and up the latter river, in all some 14 or 15 miles.

Robert Fulton.— After the withdrawal of Fitch from the activities of steam navigation, and the death of Rumsay, there does not seem to have been that mania for the application of steam to navigation. It languished for a time, but not long: for Robert R. Livingston of New York, who had been interested in Morey's experiments, was granted by the New York legislature the exclusive privilege of navigating the waters of the Hudson with a vessel propelled by steam. Livingston was a man of wealth, and had a taste for mechanics. He was associated with John Stevens and Nicholas J. Roosevelt in experiments with a steamboat that year, but the results were unsatisfactory, the best speed attained being three miles per hour, while the State requirements were four miles. Other trials were made the next year with another vessel, but with no better success. The grant by the State had now expired. Robert R. Livingston had been appointed Minister to France, and while there had met Robert Fulton, who had been engaged in experiments with the application of steam to navigation, among other things, and in 1803 made a trial with a boat propelled by paddle wheels, which showed with improvement in the engine they might look for better results. The French paid no attention to these achievements, and Fulton accompanied Livingston back to America. Livingston had the legislative privileges restored to him and Fulton, for two years, by the legislature. As those were not complied with, it was extended in 1807 for two years. John Stevens, then of New York, but later of Hoboken, N. J., was also a man of large means, with a mechanical turn of mind. His trials with the screw propeller began in 1802 and lasted until some time in 1806. In 1804 he had in operation on the Hudson a small vessel with a tubular boiler propelled by twin four-bladed screws, which attained a speed of about nine miles per hour. This was the first practical application of the propeller to a vessel. But the men who at that time were working with steamboats had their minds set upon paddle-wheels, and the screw propeller was ignored. Robert Fulton before leaving Europe in 1806 had parts of a steam-engine built to his order by Boulton and Watt of Birmingham, England, that were shipped to New York. He had the hull of a vessel constructed at New York in 1806–07, and the engine from Boulton and Watt was fitted on board. This vessel was named *Clermont.* It was 140 × 13 × 7 feet deep, and the engine having a bell crank motion, had a cylinder of 24 inches diameter and four feet stroke. Her trial trip from New York to Albany was commenced on 17 Aug. 1807. The vessel was enlarged during the following winter and rechristened the *North River.* As there was no part of the original *Clermont* that was an invention of Robert Fulton, though he obtained patents at a subsequent date on improvements, his theoretical knowledge of steam navigation and its adaptation to practical purposes was the cause of his success. He knew very nearly all that had been done in the way of experiments, and his ability lay in selecting those features that were of value and bringing them together so

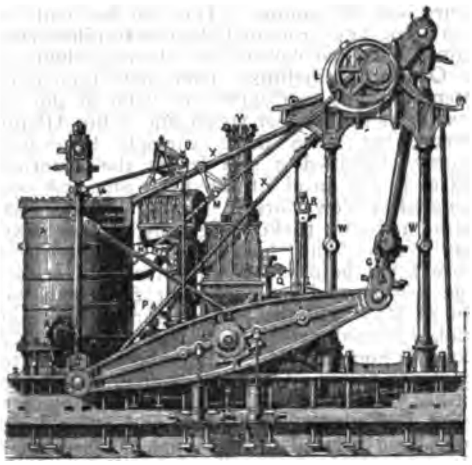
Fulton's *Clermont* (1807)

they were first seen in the *Clermont.* He must certainly have had mechanical ability of no mean order for that day to have accomplished so much at one stroke. The first complete American-built steamboat, both hull and machinery, was the *Phœnix,* constructed in 1808 by John Stevens; and as Fulton held the exclusive privilege of New York waters for steam vessels, Stevens sent the vessel around to the Delaware River, leaving New York 8 June 1809, to form part of a line between New York and Philadelphia. About the same time the *Raritan* was built to run from New York to New Brunswick, N. J., to form the New York end of the New York and Philadelphia line. This vessel was run in the interest of the New York monopoly.

Early Ferry-boats.— Fulton and his associates, or the North River Steamboat Company, met much opposition in the proposition of their enterprise, and it became so bold after a time in placing obstacles in the way, during the running of their vessels, that they were compelled to resort to the legislature of the State for a law to protect them in their lawful rights. There was one company which built two boats that were originally fitted with experimental engines, that were removed almost as soon as erected on board, and steam-engines and boilers substituted, in defiance of the monopoly of the Fulton company. After three years in the courts the vessels were delivered into the possession of the Fulton company, who broke them up. This exclusive privilege was the cause of a petition being laid before the New York legislature in 1814 by Aaron Ogden of New Jersey, who desired to run a steamboat on his ferry to Elizabethtown, N. J., but was prevented by Livingston and Fulton. The matter was at length compromised so that Ogden ran his boat. He had a partner in his ferry property named Thomas Gibbons of Savannah, Ga., who opened an opposition line to Ogden, and it was on this route and line Cornelius Vanderbilt began his steamboat career. This opposition, commenced in 1818, was the cause of the lawsuit that was carried to the United States Supreme Court, where in 1824 a decree was entered against Ogden, thus breaking down the steamboat monopoly. The steam ferry-boat was first brought into use by Robert Fulton, on the Fulton ferry running from New York to Brooklyn in May 1814.

Hudson River Boats.— After the waters of the United States were thrown open to the free navigation of steamboats in 1824, the number of steam vessels increased on the Hudson River, as that was the most expeditious mode of travel from New York to Albany, as well as the best patronized channel of travel from the seaboard to the Western States, that were just then being opened to the settler. The new vessels were great improvements over the vessels of the North River Company, that now in many instances became tow-boats. For nearly 10 years later several lines were formed that were well backed financially for that period, until in 1832, when they were all consolidated. In 1835 the People's Line was opened with the *Westchester* and the *Emerald.* The most noted of the boats of this period were the *Swallow* and the *Rochester,* that were rivals on the New York and Albany route, and for several years were very often engaged in racing. This was the opening stage of that fierce rivalry between the lines on the river that was so well known for many years, when at times, so intense has been the competition, passengers have been transported the entire length of the navigable river free of cost of carriage. This lasted until 1852, when the steamboat law went into effect, which brought the operation of our steamboats under the United States law. And it was well it did even at that late date. The completion of the Hudson River Railroad in the latter part of 1851 had a great effect in diminishing the number of steamboats on the river. Since then the business on the river has been in the hands of companies that have been strong financially, and who have catered to the public travel with the better class of vessels suited to the service. The present Hudson River Day Line was started in 1863 with the *City of Albany,* and was incorporated in 1879. The People's Line of night boats, or New Jersey Steamboat Company, had built in 1896 the *Adirondack,* that was a marked advance upon the form of the previous vessels of the line. Their first steel hull vessel, the *C. W. Morse,* appeared in 1904. The second *Hendrick Hudson* was launched in 1907, and leads the Day Line fleet, which includes also the *Robert Fulton* and the *Washington Irving.* There have been at different periods several fine boats on the river possessed of high speed that may be mentioned, such as the *Daniel Drew; Mary Powell,* the fastest vessel known until the torpedo-boat destroyer was devised, having a speed record of 27 miles per hour; *Thomas Powell;* the *Alida,* and the first *Hendrick Hudson.*

Long Island Sound.— Communication by water on Long Island Sound dates back to 1813–14 when the *Fulton* was constructed for service from New York to New Haven by Captain Bunker, whose boats *Hope* and *Perseverance* on the Hudson had been seized by Fulton and Livingston under their monopoly, and broken up. On account of the War of 1812 and the activity of the British naval vessels off our coast at the time, it was deemed prudent to postpone the opening of the new line. It was not until 21 March 1815 that the vessel was placed on the route. The *Firefly* was the first steamer to round Point Judith and sail into Newport. This was in May 1817. In 1818 the *Connecticut* was brought out in the same interest, and run from New York to New Haven, while the *Fulton* was run from New Haven to Norwich, Conn., as it was considered unwise to run a boat on such a long route as from New York to Norwich, Conn., at that time. These vessels thus ran until prevented by the passage of the retaliatory law by Connecticut in 1822, when they ran to Providence, R. I. The *United States* was purchased in 1822 by New Haven parties and ran to Byram Cave, N. Y., and this service continued until the exclusive privilege of Fulton and others was declared unconstitutional, when the vessel was run direct from New York to New Haven. This was the beginning of the New Haven Steamboat Company. Other vessels followed of improved construction, and larger and better accommodations. They had their periods of opposition and low fares as on other important routes. One of the fastest vessels that has thus far been on the line has been the *Richard Peck*. In 1899 a duplicate of this vessel, the *Chester W. Chapin*, was added to the line. Providence, R. I., was first served with a steamboat line in 1822. In the following six years three new steamboats were built for the line to New York, and during this period opposition began on the route. This had then become the most popular route from New York to the Eastern States. In 1835 Cornelius Vanderbilt placed the *Lexington*, then a new boat, on the route, and being one that developed in a short time higher speed than those on the old line, drew a greater portion of the passenger travel. The Boston and New York Transportation Company had the *Boston*, the *Providence* and the *Massachusetts* in 1836. The *Lexington* was again on the route in 1836, and having made it lively for the old company, they had the *Narragansett* built, to be on even terms with the opposition, as they thought; but they were mistaken. The *Lexington* was purchased by the Transportation Company in 1838, as another opposition line with the *J. W. Richmond* had presented itself for public favor. The *Lexington* took fire while on a trip from New York to Stonington on 13 Jan. 1840 when off Eaton's Neck, Long Island. There were at least 150 persons on board, and all were lost except four. After 1845 the passenger service to Providence fell off to a great extent, and it was many years before it was resumed with a first-class passenger line. Stonington had become the popular route. The New Jersey Steam Navigation Company controlled the business of this route from 1840 to 1867, when they withdrew their boats from the service. A first-class passenger line was not resumed to Providence until 1877, when the *Rhode Island* and the *Massachusetts* were placed on the route by the Stonington Steamship Company, and then began the war of rates that lasted so long on Long Island Sound. These boats were followed by the *Connecticut*, and later by the *Plymouth* and others. The Joy line commenced running to Providence in 1899. After the Stonington line was closed up in 1867 there were no steamboats running to Stonington until January 1868, when the Stonington Railroad Company and others organized the Stonington Steamship Company, and ran the *Narragansett* and the *Stonington*. These vessels were succeeded by the *Rhode Island* (No. 3) and later by the two propellers *Maine* and the *New Hampshire*. The Fall River Line was opened in 1847 with the *Bay State*, much the largest and fastest steamer of her time, and the next year the *Empire State* was added, and a few years later the *Metropolis*. The company was reorganized in 1863 and a new fleet of boats built for the line that did service until the consolidation with the Narragansett Steamship Company in 1874. The two famous steamers *Bristol* and *Providence*, of the Merchants' Shipping Company, merit distinguished remembrance. The first iron hull vessel, built with 96 water-tight compartments, was the *Pilgrim*, added to the Fall River Line in 1883, and subsequently the floating palaces, *Puritan*, *Plymouth* and *Priscilla* were placed in commission. The *Commonwealth*, the largest and fastest of the Fall River fleet, represents the very highest type of American river steamer of the sturdier class of side-wheelers. To New London and Norwich, Conn., there were several lines run up to 1860, when the Norwich and New York Transportation Company was organized, and the *City of Boston* and *City of New York* were built. A few years later three smaller passenger and freight boats were built. In 1881 their first iron hull steamboat, *City of Worcester*, was placed in service, and in 1894 the steel hull twin-screw propeller *City of Lowell* was added to the line. This vessel has proved to be one of high speed.


The Side-lever Engine (1849).

Lake Steamers.— Steam navigation on the Great Lakes dates from the year 1818 when the *Walk-in-the-Water* was built to run on Lake Erie. The most radical departure in steamboat design and construction on the Lakes was in the building of the *Great Western* in 1838, by the adding of the upper cabin with staterooms, and converting the lower cabins into steerage quarters and freight compartments. There were several fine and large side-wheel passenger boats built after 1845, after the general style of the Long Island Sound boats. By 1849 there were 29 side-wheelers and 10 propellers running out of Buffalo; and by 1862 the number had increased to 147 side-wheelers and 203 propellers. The extension of the railroads along the shore of Lake Erie soon made their business unprofitable. Since 1880 there have been several large iron or steel hull passenger boats built to run from Buffalo and Cleveland to Detroit, and fitted with large engine power, that have proved themselves to be vessels of very high speed. Lake Ontario had its first steam vessel in the *Lake Ontario* built in 1816. There were several lines of beam-engine boats on the lake up to 1860, when the railroads, having absorbed the greater part of the business, several of the vessels were brought to the coast by running the rapids of the Saint Lawrence River. The finest passenger steamer on the Great Lakes is the *City of Cleveland*, running between Detroit and Cleveland. The largest cargo vessel in those waters is the *William M. Mills*, with a capacity of 514,500 bushels of wheat, or 12,380 tons of iron ore. Prominent among the Canadian-built lake steamers are the immense freighters *Collingwood* and *Midland Prince*.

Coast of Maine Steamboats.— The coast of Maine was first visited by a steam vessel in 1823. There were many vessels running from Boston, Mass., to Portland, Me., and the coast towns up to 1845, when the Sanford line began operations. The Portland Steam Packet Company began their operations in 1843. The iron hull propeller *Bangor,* running from Boston to Bangor, Me., began its service in 1845. The International Steamship Company, running from Boston to Saint John, New Brunswick, began operations in 1859. All the lines running from Boston to the coast of Maine were consolidated in November 1901.

Western River Steamboats.— The first steamboat constructed for the Western rivers was the *New Orleans,* built at Pittsburgh, Pa., in 1811 under the supervision of Nicholas J. Roosevelt for Livingston and Fulton. Several vessels were constructed for these waters during the next decade, but of a different form of hull and type of engine, several of them being more like those of a later date. The conditions under which the steamboats on the Western rivers are operated are so different from those on other rivers of the United States that they are required in design to conform more closely to the surrounding conditions. The shallowness of the channel makes it necessary for the hulls of these vessels to be of great length and width in proportion to the depth of hull. The engines are all poppet valves, worked by levers, with the cylinders set horizontally on wooden frames, generally. The boilers are usually plain cylinder with two flues each. They are worked non-condensing under a pressure of 100 to 125 pounds to the square inch. They are usually fitted with side wheels, but the stern-wheel boat has been favored for some service. There were a few compound engines in boats on the rivers several years ago, which type of engine has gained in favor again on the Western rivers in more recent times. Before the railroads in the Western States became so numerous, the passenger and freight business in that section of the country was largely carried on by the steamboats, and at that time there were many fine and fast steamboats on the Mississippi and the Ohio rivers, and a few of large dimensions. Among the earlier steamers on the Mississippi were the *Moselle* and *Oronoko,* memorable for their boiler explosions; and the *Pioneer* and *Ontario,* which raced often on the Ohio. There was in 1852 the *Eclipse* of 363 feet long with two engines of 36 inches by 11 feet stroke each. The *J. M. White* of 1844 of 250 feet long, with two engines of 30 inches by 10 feet stroke each. Then at a later date the *Grand Republic* of 1876 of 350 feet long with two engines of compound type. The *J. M. White* of 1878 was 321 feet long with two engines 43 inches by 11 feet stroke each, and water wheels 45 feet diameter and 18 feet 6 inches face. The famous race of the *Natchez* and *Robert E. Lee* on the Mississippi River began on the afternoon of 30 June 1870 from New Orleans, and ended at Saint Louis on the morning of 4 July. The latter made the 1,218 miles in 3 days 18 hours and 30 minutes. The *Natchez* had run into a fog and grounded about 300 miles below Saint Louis that delayed her about six hours.

River Steamer (1895).

Ocean Steamships.—There have been a few attempts made to dispute the claim of the *Savannah* as the pioneer steamship of the Atlantic Ocean, but when these attempts have been closely examined it still leaves the American vessel at the head of the list. She was constructed at New York in 1818 by Francis Fickett as a sailing packet originally, but an auxiliary engine and boiler with paddle-wheels were fitted before she was placed in service. She was owned by parties at Savannah, Ga. On 24 May 1819 she left Savannah for Liverpool, England, which port was reached in 27 days, 80 hours of which time she was operated by steam power. On 29 September she started on her return to the United States, stopping at Saint Petersburg, Stockholm and other Baltic ports, and arrived at Savannah 30 November. Subsequently her machinery was removed and the hull converted to a sailing vessel. and run between New York and Savannah, Ga., until driven ashore on Great South Beach on Long Island, 5 Nov. 1821, during a gale, where she became a total loss. The *Rising Star,* built for the government of Chile, made the next westward crossing of the Atlantic in 1822, arriving in Valparaiso in April. She was a full-rigged ship with an auxiliary steam-engine. There was a long interval of time before another American steamship crossed the Atlantic Ocean, but during that period much knowledge had been gained of steam navigation that was of use in constructing ocean steamers. The Ocean Steamship Company in 1847 had the *Washington* and the *Herman* built for a line from New York to Bremen, they having obtained a contract to carry the United States mail for 10 years. In 1849 the New York and Havre Steam Navigation Company obtained a contract to carry the United States mail to Havre, and during the same year had the *Franklin* and the *Humboldt* constructed for the line. The latter vessel having been lost in 1853, and the former in 1854, the company ran the line with chartered vessels until the *Arago* and the *Fulton* were built and placed on the line in 1855. This line was well managed and received more American patronage than any other running to the same ports. These vessels ran until the opening of the Civil War in 1861. The next line of American ocean steamships was the Collins line, organized about 1847 as the New York and Liverpool United States Mail Steamship Company. The *Atlantic* and the *Pacific* were built in 1849, and the next year the *Baltic* and the *Arctic* and *Antarctic* were constructed for them at New York. The general dimensions of these vessels were each 277 feet long, 45 feet beam and 31 feet depth of hold. Their motive power was a pair of "side lever" engines, the first two vessels built having cylinders 95 inches by 9 feet stroke, while the others were larger. These engines were of

1,000 horse power and the vessels were of 2,860 tons. The line started under a contract to carry the mail for $385,000 per annum, which was subsequently increased to $858,000: yet with this large mail pay or subsidy, just as it is viewed, and a large share of the passenger travel and freight, it failed to be a paying line. The rivalry existing with the Cunard line at this time was very great and the expenses of operation in making record time voyages made a heavy drain upon the finances of the company. There were also commercial and political interests that were antagonistic to the company, so that by 1857 Congress had cut down the appropriation for mail pay to less than the original amount; and as the line could not be operated successfully under these conditions the last vessel was withdrawn from the róute in January 1858. Congress virtually «froze out» the company. The *Adriatic,* a vessel of 4,150 tons, was added to the fleet in 1857, and made but one voyage in the line. The remaining vessels afterward passed into other hands. The *Arctic* was lost by collision off Cape Race on 27 Sept. 1854; and the *Pacific* sailed from Liverpool on 23 Sept. 1856 and was never heard from afterward. The *Atlantic* was broken up in September 1871; and the *Baltic* was broken up about 1880, having for some time been run as a sailing vessel, her machinery having been removed. Cornelius Vanderbilt in 1855 began the operation of a line of steamships to Southampton and Havre with the *North Star* and the *Ariel,* and during the next year ran to Bremen. At this time he had built the *Vanderbilt,* his largest ocean steamship, that ran with some one of his large fleet of ocean steamships, to either Bremen or Havre until the opening of the Civil War. There were a few attempts made after 1865 to build up an American transatlantic line from New York, but they all ended in failures. It was also tried from Boston by the American Steamship Company, who had in 1866–67 the *Erie* and the *Ontario* built. The latter vessel made one voyage and returned when laid up; while the former never made a voyage in the line.

The names of the great steamships which have ploughed the waters of the seven seas are legion and but a few may be mentioned here. For the five years following the outbreak of the Great War no notable steamships were placed in commission. The *Leviathan* of 1914 (formerly the German *Vaderland*) is still (1919) the world's largest merchant steamship; 950 feet in length, 100 feet beam and a displacement of 58,000 tons. Its four turbines of 90,000 horse power drive four propellers, attaining a speed of 25.8 knots. The *Imperator,* also a German vessel seized by the United States in the war, is the second largest of the world's vessels. It was placed in commission in 1913. It is 909 feet long, 98 feet beam and of 52,000 tons displacement. Its turbines drive four propellers with 60,000 horse power, developing a speed of 22.5 knots. The *Aquitania,* a Clyde-built steamer of 1914, has a length of 901 feet; beam of 97 feet; displacement of 53,000 tons; engines of 60,000 horse power and a speed of 23.5 knots. The *Olympic,* of 1911, has a length of 883 feet; beam of 92½ feet; displacement of 52,000 tons; engines of 60,000 horse power; and a speed of 22.5 knots. The *Mauretania* (1906) is 790 feet long; 87½ feet beam; 41,550 tons displacement; with engines of 74,000 horse power, developing a speed of 26.06 knots. These are the five largest vessels now in ocean service.

The American Liners.— In 1871 the American Line, controlled by the Pennsylvania Railroad Company, was organized to run a line of steamships from Philadelphia, Pa., to Liverpool. It will be noted that this was at the beginning of the period when iron shipbuilding in the United States began to increase, and the compound marine engine was coming into favor. The company had built in 1873–74 the *Pennsylvania, Ohio, Indiana* and *Illinois.* These proved to be good, staunch and serviceable vessels for the line, though only of average speed under good conditions. They subsequently passed into the hands of the International Navigation Company, which absorbed the Inman line in 1886. The present American line is the result of an act of Congress of 1892, providing with other conditions that certain foreign-built steamships should receive American register on condition that steamships of corresponding tonnage were built in the United States. This led to the *City of Paris* and the *City of New York* receiving American register in 1893, and their names being then abbreviated *Paris* and *New York.* Contracts were then made with the William Cramp Ship and Engine Building Company for the *Saint Paul* and the *Saint Louis,* they having the first quadruple expansion engines built in the United States for the Atlantic service. These vessels ran to Southampton and Cherbourg. They are elegantly fitted and furnished in their passenger accommodations, are well patronized by the American traveling public and have shown on more than one occasion that they are possessed of more than average high speed. In January 1903, the American and Red Star lines were consolidated with four British lines as the International Mercantile Marine Company.

Coastwise Steamships.— The *Robert Fulton,* built in 1819, was the pioneer in the coastwise trade with steam vessels and ran between New York and the island of Cuba from 1820 to 1825, when it was sold to the Brazilian government. There were no steam vessels running coastwise from the latter date till 1832, when a small steamboat named the *David Brown* was refitted and run from New York to Charleston, S. C. In the next six years there were five larger vessels built for the same route, but of the same general type of vessel. After the loss of one of these vessels in 1837, public confidence in their safety became so shaken that they no longer found profitable employment on the route, and in a short time were withdrawn. The first steamships to be employed along our coast were those built in 1846–47 to run between New York and Charleston, S. C., the *Southerner* and the *Northerner.* These vessels were the pioneers of the many steam vessels that were built in a few years to run on lines between the Atlantic ports. The largest development of our early ocean steam marine began with the discovery of gold in California. During the Civil War these coastwise lines of side wheel steamers were discontinued. Then they were opened again and gradually fell into financially strong hands.

Most of them after 1870 began the construction of iron hull vessels with compound propeller engines, and by 1880 had laid aside the wooden hull vessels with the expensive beam-engine or the simple condensing propeller engine, so that at the present time we find a fine fleet of large vessels running from all our principal ports on the coast that are operated at a much less cost for same size of vessel than those in the same service 30 years or more ago.

Whalebacks.— These vessels have a main deck rounded over, and resemble the back of a whale. They are for use in rough water, the waves passing completely over them without resistance or injury. The first one was built for a Baltimore company about 1860. Such vessels are now used as grain carriers on the Great Lakes; and more recently as passenger vessels. As oil-carriers this type has been very successful upon the deep sea. Their average speed is nearly 20 miles per hour.

Double Screw Ferry-boats.— This type of vessel, having a screw at each end of the vessel, is, for ferry service, of comparatively recent date, although double-screw steam vessels were built in this country many years ago. These vessels must not be confused with a twin-screw vessel having two screws at the stern of a vessel. The pioneer of the later development was the *Bergen*, built in 1888 for the Hoboken ferry, having a triple expansion engine. Since then this type of ferry-boat has been growing in favor until at this time it has practically driven the old-fashioned side-wheeler out of use; except on the shorter ferries.

Screw Propellers.—After John Steven's experiments with the screw propeller in 1802 to 1806, there was nothing done in this country to practically demonstrate the value of the screw until the *Robert F. Stockton*, having an Ericsson propeller, was brought to this country in 1839. Then the propeller began to come into use, both on the Atlantic Coast as well as on Lake Erie and Lake Ontario, and it is altogether probable that its largest development in the first decade was on the northern lakes.

Summary.— The progress in the development of the modern steam vessel may be summarized by divisions into decades marked by salient advances.

Between 1845 and 1855 iron was substituted for wood in the hulls of steam vessels and the boiler pressure was advanced from 10 pounds to 20 pounds per square inch; the coal consumption being reduced from 4.5 pounds to 3.5 pounds per horse power per hour.

Between 1855 and 1865 the screw-propeller took precedence of the paddle-wheel as a means of propulsion; the boiler pressure was increased to 35 pounds; and the coal consumption dropped to three pounds per horse power per hour.

Between 1865 and 1875 the compound engine was introduced; the boiler pressure went up to 60 pounds; and the coal went down to 2.5 pounds per horse power per hour.

Between 1875 and 1885 steel superseded iron in hull construction, and the triple-expansion engine came into use. The boiler pressure was advanced to 125 pounds, and the coal consumption fell to two pounds per horse power per hour.

Between 1885 and 1895 twin screw propulsion with quadruple expansion engines and the principle of the forced draught were brought into use. The boiler pressure rose to 200 pounds, and the coal consumption dropped to 1.5 pounds per horse power per hour.

The decade 1895 to 1905 was one of transition. A few turbines appeared and the steam pressure in compound engines reached a maximum of 225 pounds.

Between 1905 and 1915 turbine engines came generally into use, and the boiler pressures came down to 160 to 175 pounds, at which figures the turbines were most effective. The coal consumption also decreased to 1.2 pounds per hoise power per hour. See also SHIPBUILDING; WARSHIPS.

J. H. MORRISON,
Author of 'History of American Steam Navigation.'

STEAMBOATS. See STEAM VESSELS.

STEAMSHIP SPEEDS. See SPORTS, THEIR DEVELOPMENT, SPEEDS AND RECORDS.

STEAMSHIPS. See STEAM VESSELS.

STEARATES. See STEARIC ACID.

STEARIC ACID, N — Octodecylic Acid, $C_{17}H_{35}COOH$, occurs in large quantities as a glycerol ester in animal and vegetable fats. Palmitic acid, $C_{15}H_{31}COOH$, and oleic acid, $C_{17}H_{33}COOH$, are usually associated with stearic acid in these sources. Animal fat contains the glycerol esters of all three acids in varying quantities, depending upon the nature of the fat. Shea-butter, a vegetable fat obtained in West Africa, contains the glycerol esters of stearic and oleïc acids only. When these fats are saponified and then treated with a mineral acid, a mixture of the acids is produced. In the preparation of these acids from fat, saponification may be brought about by the use of lime, superheated steam or sulphuric acid. The mixed acids are fractionated by first pressing between warm plates in order to remove liquid oleïc acid. The residue is then dissolved in alcohol and poured into an alcoholic solution of magnesium acetate; magnesium stearate precipitates first, yielding free stearic acid when treated with a hot solution of hydrochloric acid. The product may be purified by crystallization from alcohol.

A number of synthetic processes have also been developed for the preparation of stearic acid. It may be obtained: (1) By heating oleïc acid with hydrogen iodide and red phosphorus at 200°–210° C.; (2) by the direct addition of hydrogen to oleïc acid or other unsaturated acids, in the presence of nickel or other reduced metallic substances, the metals acting as catalysers. According to United States patent 1,209,512, stearic acid, suited for the manufacture of candles or high-grade toilet soaps, can be produced by hydrogenating fatty materials like tallow, in the presence of finely divided nickel, until the iodine number is reduced to zero and the melting point is raised to 62° C. The product is saponified and the acids extracted are purified. Stearic acid is a white crystalline solid with no taste or smell. It melts at 69.32° C. and boils at ordinary pressures with partial decomposition at 360° C. The acid is insoluble in water, but will readily dissolve in boiling alcohol and ether. The potassium or sodium salts of stearic acid are the chief constituents of soft or hard soap. Commercial stearic acid, known as "stearin," contains a large quantity of palmitic acid. In order to destroy its crystalline structure stearin is usually mixed with wax or paraffin; it is extensively used for the manufacture of candles, stove polish, shoe polish and varnish. Pure stearic acid is used for the preparation of glycerin suppositories.

V. S. BABASINIAN,
Lehigh University.

STEARIN. See STEARIC ACID.

STEARNS, Frederick Pike, American hydraulic engineer: b. Calais, Me., 11 Nov. 1851. He was connected with the city surveyor's office, Boston, Mass., in 1869–72; with the construction and maintenance of the additional water supply of Boston in 1872–80; with the main drainage works of that city in 1880–86. He was chief engineer of the Massachusetts State Board of Health in 1886–95; a member of the board of sanitary engineers to devise a sewage system for the District of Columbia in 1889–90; and chief engineer of the Massachusetts Metropolitan Waterworks in 1895–1907. He served as consulting engineer to the Charles River Basin Committee in 1903–10 and to the New York Board of Water Supply from 1905. He was a consulting engineer of the Panama Canal in 1905–06. He served on the boards making reports on the Los Angeles waterworks in 1908, the Baltimore water supply in 1908–09, and that of Winnipeg in 1913. He has been consulting engineer for the new water supply of Providence, R. I., since 1914. He was president of the American Society of Civil Engineers in 1906.

STEATITE, the mineralogical name for soapstone. See TALC.

STEBBINS, George Coles, American evangelistic singer: b. East Carlton, N. Y., 26 Feb. 1846. He studied music in Rochester, Chicago and Boston. He was director of music at the First Baptist Church, Chicago, in 1870–74, and at the Clarendon Street Baptist Church, Boston, in 1874–76. In 1876–99 he was engaged in evangelistic work as a singer with D. L. Moody and I. D. Sankey, touring the United States and Great Britain. He later made tours in Egypt, Palestine and Europe. From 1880 he was conductor of music at the Northfield, Mass., Conference. He collaborated with Sankey and McGranahan in editing 'Gospel Hymns' (Nos. 3–6), and compiled 'The Northfield Hymnal' (1904).

STEDMAN, Charles, English military historian: b. Philadelphia, Pa., 1753; d. London, England, 26 June 1812. He was educated at the William and Mary College. In the Revolutionary War he enlisted in the British army and served at Lexington, Bunker Hill and under Cornwallis in the south. At the end of the war he was retired on the half-pay of a colonel and returned to England. He served on a committee to examine and settle the claims of the American loyalists, and in 1797 was appointed deputy controller and accountant-general of the stamp office. His 'History of the Origin, Progress and Termination of the American War' (2 vols., London 1794) is the standard British work on the American Revolution and contains military maps of high value. Its accuracy in minor details was questioned by Sir Henry Clinton in 'Some Observations upon Mr. Stedman's History' (1794).

STEDMAN, Edmund Clarence, American poet and critic: b. Hartford, Conn., 8 Oct. 1833; d. New York City, 18 Jan. 1908. He studied at Yale, and in 1856 began contributing to various New York journals. He was Washington correspondent of the *World* in 1861–63; he held a post in the office of Attorney-General Bates; but in 1869 entered business in New York, where until 1900 he was a member of the stock exchange. After the appearance of his first collection, 'Poems, Lyric and Idyllic,' in 1860, he published several books of verse, such as 'The Blameless Prince, and Other Poems' (1869); 'Hawthorne, and Other Poems' (1887); 'Lyrics and Idyls, with Other Poems' (1879); and 'Poems Now First Collected' (1894). 'Pan in Wall Street' is one of his best poems. His 'Victorian Poets' (1875) passed through many editions. It is a judicial, careful and sufficiently learned work, and much better than his 'Poets of America' (1885). He also edited a 'Victorian Anthology' (1895) and 'An American Anthology' (1900), the latter of which was criticized for too great catholicity, while both displayed wide knowledge. The 'Library of American Literature' (1888–89) was prepared by him with E. M. Hutchinson. His Turnbull lectures at the Johns Hopkins University and repeated at Columbia and Pennsylvania universities appeared as 'The Nature and Elements of Poetry' (1892). His other works include 'Alice of Monmouth,' 'Genius and other Essays,' 'The Works of Edgar Allan Poe' (with G. E. Woodberry). Consult Stedman and Gould, 'Life and Letters of Edmund Clarence Stedman' (New York 1910); Winter, W., 'Old Friends' (New York 1909).

STEDMAN, Elizabeth Clementine (MRS. WILLIAM BURNET KINNEY), American writer, mother of E. C. Stedman (q.v.): b. New York, 18 Dec. 1810; d. Summit, N. J., 19 Nov. 1889. She was a sister of D. L. Dodge, the philanthropist, was married to E. B. Stedman in 1830 and was widowed in 1836. She was married to W. B. Kinney, a newspaper publisher, in 1841, and in 1851, when her husband was appointed on the Sardinian mission, she accompanied him to Turin. She was already known as a contributor to the *Knickerbocker, Blackwood's* and other magazines, and in the 14 years she remained abroad with her husband she wrote extensively on matters of art, travel and scenery. In Italy she was associated with an interesting literary circle, among whom were the Brownings. She wrote 'Felicita' (1855); 'Poems' (1867); 'Bianca Capello, a Tragedy' (1873), etc.

STEDMAN, Fort. See FORT STEDMAN.

STEEDMAN, stĕd'man, **Charles,** American naval officer: b. Charleston, S. C., 24 Sept. 1811; d. 1890. He entered the navy as midshipman in 1828, was promoted lieutenant in 1841, and in the Mexican War was in command of the siege guns in the naval battery on shore during the bombardment of Vera Cruz. In 1855 he was appointed commander and sailed in the brig *Dolphin* in the Paraquay expedition. During the Civil War he remained loyal to the Union. In 1861 he commanded the railroad ferry steamer *Maryland* that conveyed General

Butler and the 8th Massachusetts Regiment from Havre de Grace to Annapolis; and later, after assisting Admiral Foote in organizing the naval forces along the Mississippi River, commanded the steamer *Bienville* at the capture of Port Royal, S. C. In the following year he commanded the *Paul Jones* during the engagement and capture of Fort McAllister and later operated on the Saint John's River, Florida. In September 1862 he was promoted captain, and in the *Powhatan* was engaged in the blockade of Charleston. With the steamer *Ticonderoga* he pursued the Confederate cruiser *Florida* to the coast of Brazil and took part in the two attacks on Fort Fisher in 1864. In 1865 he commanded the Mediterranean squadron and in 1866 he was promoted commodore and had charge of the Boston Navy Yard in 1869–72. He was appointed rear-admiral in 1871 and retired in 1873.

STEEDMAN, James Barrett, American soldier: b. Northumberland County, Pa., 30 July 1818; d. Toledo, Ohio, 18 Oct. 1883. He removed to Ohio in 1837 and entered the legislature of that State in 1843. In 1851 he was appointed by President Buchanan public printer at Washington, and at the opening of the Civil War became colonel of the 4th Ohio Regiment and fought in western Virginia and Kentucky in 1861–62. In July 1863, having already been promoted brigadier-general, he was placed in command of the first division of the reserve corps of the Army of the Cumberland and for his services at Chicamauga was promoted major-general 24 April 1864. He took part in the Atlanta campaign; defeated Gen. Joseph Wheeler's cavalry in June 1864 and served with General Thomas at Nashville while Sherman was making his march to the sea. He resigned from the army in 1866, retiring with the rank of major-general of volunteers. He was made provisional governor of Georgia, but resigned and received the appointment of collector of internal revenue at New Orleans. He subsequently became chief of police of Toledo and editor of the *Weekly Ohio Democrat*. In 1887 a monument was erected to his memory in Toledo.

STEEL. Before the introduction of the modern methods of steel making in the middle of the 19th century the name of steel was applied only to iron containing a sufficient percentage of carbon to become intensely hard on rapid cooling (quenching) from a red heat or higher temperature. The invention of the Bessemer and Open Hearth processes, however, by which it is possible to produce, in a molten condition, iron containing any proportion of carbon from a trace to 2 per cent or more, made a revision of the nomenclature necessary. The name of steel is now very generally applied to any iron obtained in a liquid state, provided it is malleable, regardless of the percentage of carbon it may contain and regardless, therefore, of whether it possesses or not the property of becoming hard on quenching. All malleable products manufactured by the Bessemer or Open Hearth processes are consequently classified as steel although some of them may contain but a mere trace of carbon and be as soft and as deprived of hardening power as wrought iron. Iron products which are obtained in a molten condition but which are not malleable, owing generally to too high a percentage of carbon, are classified as cast iron. Iron products which are malleable but obtained in a pasty state are classified as wrought iron. This nomenclature necessarily leaves out of consideration blister steel (also called cemented or converted steel, and by the English blister bar) which is obtained by introducing carbon (the cementation process) at a high temperature but below the melting point, into bars of wrought iron. Ingot iron (obsolete) was a term applied to steel containing too little carbon to be usefully hardened. Plated bar is blister steel in the form of bars obtained through rolling or forging while hot. Shear steel is steel obtained through rolling or forging piles or fagots of plated or blister bars. After one such operation it is known as single-shear steel. The piling and forging of bars of single-shear steel yields double-shear steel. Bessemer, Open Hearth, crucible, electric steels, etc., are steels made respectively by the Bessemer, Open Hearth, crucible, electric, etc., processes. Crucible steel is sometimes called cast steel. All steels, however, are initially cast. Eutectoid steel is steel containing in the vicinity of 0.90 per cent carbon. Hypo-eutectoid steel is steel containing less than 0.90 per cent carbon, while hyper-eutectoid steel is steel containing more than 0.90 per cent carbon (see Iron and Steel, Metallography of). Acid steel is steel made by Bessemer or Open Hearth processes when an acid (silicious) lining is used. Basic steel is steel made by the same processes when a basic lining is used. Low phosphorus pig iron must be used for the manufacture of steel by an acid process whereas by a basic process high phosphorus pig iron may be used. Alloy or special steels are steels containing a sufficient percentage of one or more special elements to cause some of its properties to be deeply modified. The alloying elements most commonly used are nickel, chromium, tungsten, molybdenum, vanadium, manganese and silicon, hence the names of nickel steel, nickel-chromium steel, manganese steel, etc. By opposition steels which do not contain appreciable quantities of these elements are sometimes termed carbon steels. High-speed steel is an alloy steel generally containing large proportions of tungsten and chromium (sometimes also molybdenum and vanadium) and which after suitable heat treatment is so resistant to wear by abrasion that it can be used as cutting tools under such severe conditions that the cutting edge of the tool may be heated to a red heat by the heat generated in cutting and still retain its cutting properties. This makes high speed cutting possible, hence the name of the steel.

Iron and carbon are the essential elements of all ordinary (carbon) steels. The carbon content may vary from a mere trace (a few hundredths of 1 per cent to some 1.5 per cent). With much larger proportions of carbon the metal ceases to be malleable and is no longer, therefore, classified as steel. Manganese is a necessary element of all steels, its introduction in the process of manufacture being necessary to obtain good forgeability. It is generally present in amounts varying between 0.1 to 1 per cent. Sulphur and phosphorus are unavoidable impurities. No steel of good quality should contain more than 0.1 per cent of either of these, while high grade steels should contain much smaller proportions. Silicon is also always unavoidably present, varying in amount between 0.1 per cent or less to some 0.3 or 0.4 per cent.

Assuming ordinary carbon steel to be in the annealed condition, i.e., having been slowly cooled from a red heat or higher temperature, as the carbon increases to 0.90 per cent the tensile strength of the metal increases from some 50,000 to 125,000 pounds per square inch, the elastic limit remaining equal to not less than one-half the tensile strength. With further increase of carbon the tensile strength decreases while the elastic limit continues to increase. The elongation which measures the ductility of the metal decreases with the carbon content from some 25 or 30 per cent in steel containing very little carbon down to some 5 per cent in very highly carburized steel. The hardness of the metal increases continuously with the carbon content while the hardening power reaches its maximum at about 0.90 per cent carbon. Very low carbon steel can be readily welded but as the percentage of carbon increases the difficulty of welding increases rapidly. Carbon lowers appreciably the melting point; while low carbon steel melts slightly below 1,500° C., steel containing 1 per cent carbon melts in the vicinity of 1,300° C. Through suitable mechanical and heat treatments the physical properties of steel can be deeply altered. Mechanical work performed while the metal is red or white hot increases its physical soundness and generally raises its strength and elastic limit. Mechanical work performed while the metal is cold greatly increases its tensile strength and elastic limit as well as its hardness, but decreases its ductility, eventually causing brittleness. The heat treatment generally applied to steel may consist (1) in annealing, i.e., in cooling slowly from a high temperature when it is desired to remove existing stresses, to produce softness and ductility, but necessarily at the expense of strength and elastic limit; (2) in hardening, i.e., in cooling quickly (quenching) from a high temperature followed generally by reheating (tempering) to a temperature seldom exceeding 400° C. when it is desired to produce implements of very great hardness, but necessarily lacking in ductility to the point of being actually brittle and (3) in hardening followed by reheating to a temperature generally exceeding 400° C. and which may be as high as 700° C. when it is desired to obtain great strength and elastic limit combined with a fair amount of ductility according to requirements.

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STEEL, THE BESSEMER PROCESS.

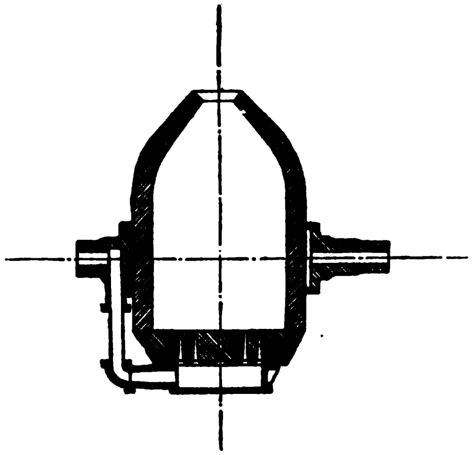
The Bessemer process is employed to manufacture from the crude product of the blast furnace a comparatively low grade of steel, which is at the same time better suited for certain purposes than that manufactured by any other process. It does not seek to make high-grade tool steel or steel castings, but a cheaper grade, for which there is an immense demand, for instance, steel rails and structural shapes. It occupies a field in which it is and probably always will be supreme, so long as the supply of suitable raw material lasts. Many modifications of the Bessemer process have been introduced, most of which have not met with approval, but one or two have become commercially recognized, such as the Clapp-Griffiths, the Robert and the Tropenas processes. These latter by variations in the method of applying the blast, or by modifications in the modus operandi, have made changes in the resulting product so that it may be successfully applied to the manufacture of castings, etc., but they are all essentially Bessemer converters. Further notes on these processes will appear later in this article.

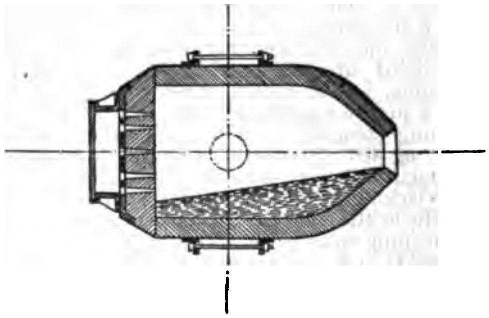
To get a fair idea of the revolutionary nature of Bessemer's invention mention must be made of the fact that before his time steel, on account of the difficulty of its manufacture, was in use for practically little else but cutlery, springs and the small parts of machines. It had to be made in crucibles by melting cemented bar or "blister steel," itself the result of a long and costly operation on Swedish iron in a cementation furnace. A steel rail, building or bridge was unthought of. Everything was wrought iron, made at great expenditure of time and human energy in the puddling furnace or charcoal bloomery.

The story of Bessemer's discovery is of unusual interest. Experiments had been made from time to time to improve iron castings by the addition of wrought-iron scrap to pig iron in a cupola, and Bessemer had achieved more success than his contemporaries by the use of a reverberatory furnace instead of a cupola, into which he had introduced great improvements such as a hollow bridge wall through which jets of air were forced, giving a higher temperature, enabling him to fuse more steel in the bath of cast iron. How he came to discover that great principle on which all air-blast processes of steelmaking are based is best told in his own words. In connection with the description of some experiments with his forced draft reverberatory furnace he says: "Some pieces of pig iron on one side of the furnace attracted my attention by remaining unmelted in the great heat of the furnace, and I turned on a little more air through the fire bridge with the intention of increasing the combustion. On again opening the furnace door, after an interval of half an hour, these two pieces of pig iron still remained unfused. I then took an iron bar with the intention of pushing them into the bath when I discovered that they were merely thin shells of decarburized iron showing that atmospheric air alone was capable of wholly decarburizing gray pig iron and converting it into malleable iron without puddling or any other manipulation. Thus another direction was given to my thoughts, and after due deliberation I became convinced that if air could be brought into contact with a sufficiently extensive surface of molten crude iron it would be rapidly converted into malleable iron."

With great enthusiasm Bessemer proceeded to the next step, namely, the experimental test of his conviction. He procured a crucible having a perforated cover and a pipe of refractory material passing through the lid, connected to a blast supply. A small quantity of cast iron was melted in the crucible and while still in the furnace a current of air was passed through it. After 30 minutes blowing the contents of the crucible were found to be soft malleable iron. The next thing to be determined was whether the chemical reactions caused by the blowing would generate sufficient heat to keep the contents of the crucible liquid without any additional heat being applied from outside. This seemed a preposterous idea — that blowing air into molten iron should only not solidify it in a short time, but actually increase its temperature very materially. But Bessemer was confident it would be so and immediately set about the construction of a converter. The first converter was about four feet in height, cylindrical, having a flat top with a circular opening, and six horizontal tuyeres around the bottom fed by a circular blast pipe. Its capacity was about 700 weight of iron, which was introduced by a sort of funnel in the side after the blast was turned on. The first blow was full of surprises, for what took place could be readily seen, whereas in the former experiments in the crucible the entire apparatus was out of sight. For the first few minutes sparks and smoke were emitted from the converter, but then a flame burst forth, which increased in violence so that no one could go near the converter. Then the flame died down and the metal was tapped out through a hole in the bottom of the converter, and found to be malleable. The possibilities of the process were now demonstrated beyond the slightest doubt, but prodigious labors were yet to be undertaken in order to make it mechanically perfect. The chief difficulties were that during the operation large quantities of slag and some drops of iron were blown out of the converter, and that the blast had to be kept on during the whole time of introducing the charge and also tapping it out when converted. Many changes were made in the interior shape to obviate the first. The height was increased and a double dome-shaped top added with the idea that any projections of slag and iron would strike the dome and drop back into the converter. This was fairly successful and was the type of converter used in the first public exhibition of the process. In order to overcome the necessity of keeping up the blast while filling and emptying the converter the shape which is so well known to-day was evolved after a great many changes and experiments. It had to be a movable vessel, in order to bring the metal away from the tuyeres and permit of shutting off the blast, and so a shape somewhat oval, and with a mouth inclined to one side at an angle, the whole mounted on trunnions, became the standard Bessemer converter. Other vast improvements came quickly, the hydraulically driven rack and pinion to rotate the converter, the hydraulic crane for handling the ladle and the casting pit for handling of ingots and molds. One of the difficulties encountered was the mixing of the slag with the iron, and this was overcome by providing a ladle having an opening at the bottom which was closed by a refractory stopper attached to a rod. The iron was run into the ladle and the stopper held in position till it was full. Then as the slag floated the stopper was withdrawn, allowing perfectly clean metal to run into the ingot molds.

The Bessemer process has another peculiar and romantic feature in its history in that it has been twice invented. When he took out United States patents in 1856 Bessemer was confronted at once by a priority of claim to invention by William Kelly. The contention was sustained in the United States courts and Kelly was granted a patent. It is now not doubted that while the two men independently and separately discovered the principle, Kelly was ahead of Bessemer some eight or nine years in his discovery. Kelly was in the iron business in Eddyville, Ky., in 1846, refining iron in an old-fashioned refinery, to make kettles used in the manufacture of sugar. He was an inventive genius, but a poor business man. An inspiration came to him one day while watching the progress of his refinery, on noticing that at a certain place where the blast of air happened to play on the molten iron direct without the intervention of any fuel, it became white hot and boiled violently. He immediately realized the revolutionary nature of his discovery and his knowledge of metallurgy easily furnished him with the explanation, namely, that the carbon content of the iron was acting as fuel, and by its combustion increasing the temperature of the iron. It was later discovered that the largest addition of heat arose from the oxidation of the silicon content, and that where less than one per cent of silicon exists in the iron the Bessemer process fails. On speaking of his hopes he was met with derision, but proceeded to make a public demonstration which convinced all who saw it. But, as with nearly all important dis-





Modern Rotary Converter.

coveries, there was a hard battle ahead of Kelly. There is always a prejudice against revolutionary discoveries, and Kelly's customers refused to accept iron refined by the new method even though it passed the customary tests. His financial backing was also withdrawn, but Kelly could not be extinguished. How he persevered with his process when experiment after experiment failed, how he worked secretly in the forest, and finally got permission from the Cambria Iron Works to erect a converter (the eighth he had constructed) in their works, and how after a disastrous commencement success was finally achieved, are familiar stories. Kelly was recognized as the inventor of the Bessemer process, and while Bessemer's patents were refused renewal, Kelly's were renewed. He died in 1888.

The Bessemer Process To-Day.— In modern American practice the pig iron is sometimes used direct in a fluid condition from the blast furnace and sometimes remelted in cupolas. Rapid working is the object aimed at so as to avoid loss of heat by radiation, and permit of the use of lower silicon in the pig iron. To-day but little more than 1 per cent of silicon is permitted in the charge and the blow is made in from 9 to 12 minutes. With a larger proportion of silicon the blow is unduly prolonged. Even with this comparatively low content of silicon the blows are sometimes too hot and steel scrap has to be added in the converter during the blow to cool it off. In place of scrap a jet of steam is sometimes turned on. As regards the capacity of the converter anything less than 10 tons is considered a small converter and the usual amount treated at one time is from 10 to 20 tons. Two types of the Bessemer process are in use, known respectively as the acid process and the basic process. The difference lies in the character of the lining with which the converter is fitted. In the first named type this lining is of acid material, chiefly silica (held together with fire-clay); and in the second type it is of basic quality, generally calcined dolomite, held together with a small proportion of tar. In the latter case a percentage of lime is added to the charge before the blowing begins — the purpose being the formation with the silica of a basic slag which does not attack the lining.

In the acid process the sulphur and phosphorus elements of the iron are not removed, the acid slag refusing to dissolve them. It is imperative, therefore, that iron selected for the acid process should contain less than .10 per cent of phosphorus and less than .08 per cent of sulphur in order to yield a grade of Bessemer steel acceptable to the market. In the basic process the oxidized silicon is readily absorbed by the basic slag, and hence is more quickly removed than it is in the acid process. The carbon ingredient is next eliminated; and following that condition the phosphorus and a part of the sulphur are absorbed by the basic lime slag. The basic process is most largely in use in regions where the phosphorus content of the iron is large — particularly in Germany and Great Britain. In the United States the acid process prevails almost universally. The lining generally consists of brick, sand or stone and the walls are lined to a thickness of about one foot. The bottom section of the converter containing the tuyeres is separate from the main section and is about 26 inches thick on account of the great amount of corrosion that takes place there and each vessel has a number of extra bottoms so that they can be quickly changed when burned out. The diameter of the tuyeres is about half an inch. The pressure of blast varies from 30 to 10 pounds, the former being used at the commencement of the blow and the latter being the lowest it would ever be safe to reduce it to, and this only when the blow is particularly hot or the projections of slag excessive. Sufficient air must always be kept on to support the iron and prevent it running into the tuyeres and wind box. The converters are rotated to suit the exigencies of blowing, and receiving or pouring the metal, by means of a pinion attached to the trunnion, and a hydraulically driven rack. The illustrations to this article give a good idea of the development of the converter from the earliest type.

The Clapp-Griffiths Bessemer.—This process, which is now practically obsolete, was one of the earlist types of Baby Bessemer converters. Its capacity was from two to three tons. A stationary side-blown converter was used, having a slag spout at one side from which the slag poured during the boil. The converter was in two sections, being jointed on a line above the tuyeres and the bottom section was handled and put in place on a car which could be lifted by a hydraulic ram. The only original feature of the converter was the slag spout, and the benefit derived from its use was always problematical. It was claimed that the steel made in this converter, even though high in phosphorus, was vastly superior to that made in ordinary converters. This claim was of course not substantiated.

The Robert Process.— In this process a rotary converter was used with horizontal tuyeres placed tangentially, in order to impart a rotary motion to the metal. The tuyeres were submerged, but near to the surface of the bath. Whilst the loss was greater than in the ordinary vessel, a hotter steel was made, which was suitable for steel castings, and for this purpose it was almost exclusively used.

The Tropenas Process.— This has been by far the most successful development of the Bessemer process for casting work, introducing the idea that the violent mechanical disturbance of the bath is unnecessary and that the more tranquil the bath is the purer, sounder and better will be the steel. A rotary, side blown converter of two tons capacity is used, and the tuyeres are arranged in a symmetrical position from the centre tuyere in order that any tendency to stirring or rotation may be neutralized. The tuyers, moreover, are never beneath the surface of the metal, though they approach it very closely. A second row of tuyeres is placed a few inches higher than and parallel with the lower tuyeres, and when the carbon flame appears these tuyeres are opened, admitting air to complete the combustion of carbon from CO to CO_2. The result of this is to increase the temperature of the bath by radiation. A high silicon, high manganese mixture is used in the converter, and results in exceedingly hot and fluid steel, which can be carried around in hand ladles and poured into very small and complicated shapes.

When the blast is first started the surface only of the metal is oxidized, three pounds pressure of air being used, and by dilution and change of specific gravity a fresh surface is constantly presented to the action of the blast without any mechanical disturbance whatever. In this way the possibility of occluded gases is reduced to a minimum, no more air being introduced than is necessary for the chemical reaction. The fact remains, however, that for casting basic open hearth steel is greatly preferred.

The Roll of Honor.—The history of the development of the Bessemer process in the United States is the history of a company of the brightest minds this country has produced. There is no doubt that the Bessemer process is worked more perfectly in America than elsewhere, and the credit must be given to those brilliant men who in the early days gave their great intellects to its problems and overcame them. The most important work has been done by A. L. Holley, John and George Fritz, William R. Jones and Robert W. Hunt. To Alexander Lyman Holley one of, if not the foremost American engineers, were granted 10 patents in connection with the Bessemer process alone, some of them being raised converters, hydraulic cranes, accumulating ladles and converter bottoms. Holley investigated the Bessemer process in England in 1863 and realizing its possibilities and also its defects obtained the only American license, and set to work to perfect its machinery. The latest and most important of the modern improvements is the Jones metal mixer, which is a large storage receiver in which the various quantities of iron direct from the blast furnace are stored and equalized, so that the silicon is uniform in the converter. One of the most important links in this perfectly welded chain was the work of Robert Mushet, who developed the method of recarburizing the iron after blowing in the converter. The Swedish method of checking the blowing when the carbon had been reduced to the proper percentage proved too slow and uncertain. Mushet's plan was to burn out all the carbon and restore a right proportion by the addition of a quantity of melted spiegeleisen (about 10 per cent) after the blow. Without his method the Bessemer process could not have been a commercial success. Considerable trouble was caused in the early days by the confliction of the Bessemer and Kelly patents. The Winslow, Griswold and Holley Company at Troy had control of the Bessemer patents covering the important and essential machinery, and the owners of the Kelly and Mushet patents could not operate without the use of this machinery. In fact each side was necessary to the other and naturally this resulted in an agreement by which a joint-stock company of all the pneumatic steel manufacturers was made. All the patents on these processes have now expired. According to the 1914 census of manufactures there were in the United States in that year 9,146 plants engaged in the manufacture of Bessemer steel. Their combined product was 6,219,304 tons of ingot steel and 43,437 tons of castings. The decline in the use of Bessemer steel in favor of open hearth steel is markedly indicated by the decrease of nearly 3,000,000 tons in the annual production for the census period 1909–14 for the former and an equal gain for the latter. The production of open hearth steel in 1914 was over 17,000,000 tons — nearly three times that of the Bessemer product. See STEEL — OPEN HEARTH MANUFACTURE. Consult Hall, J. H., 'The Steel Foundry' (New York 1914); Harbord, F. W., and Hall, J. W., 'The Metallurgy of Steel' (London 1918); Stoughton, B., 'The Metallurgy of Iron and Steel' (New York 1913).

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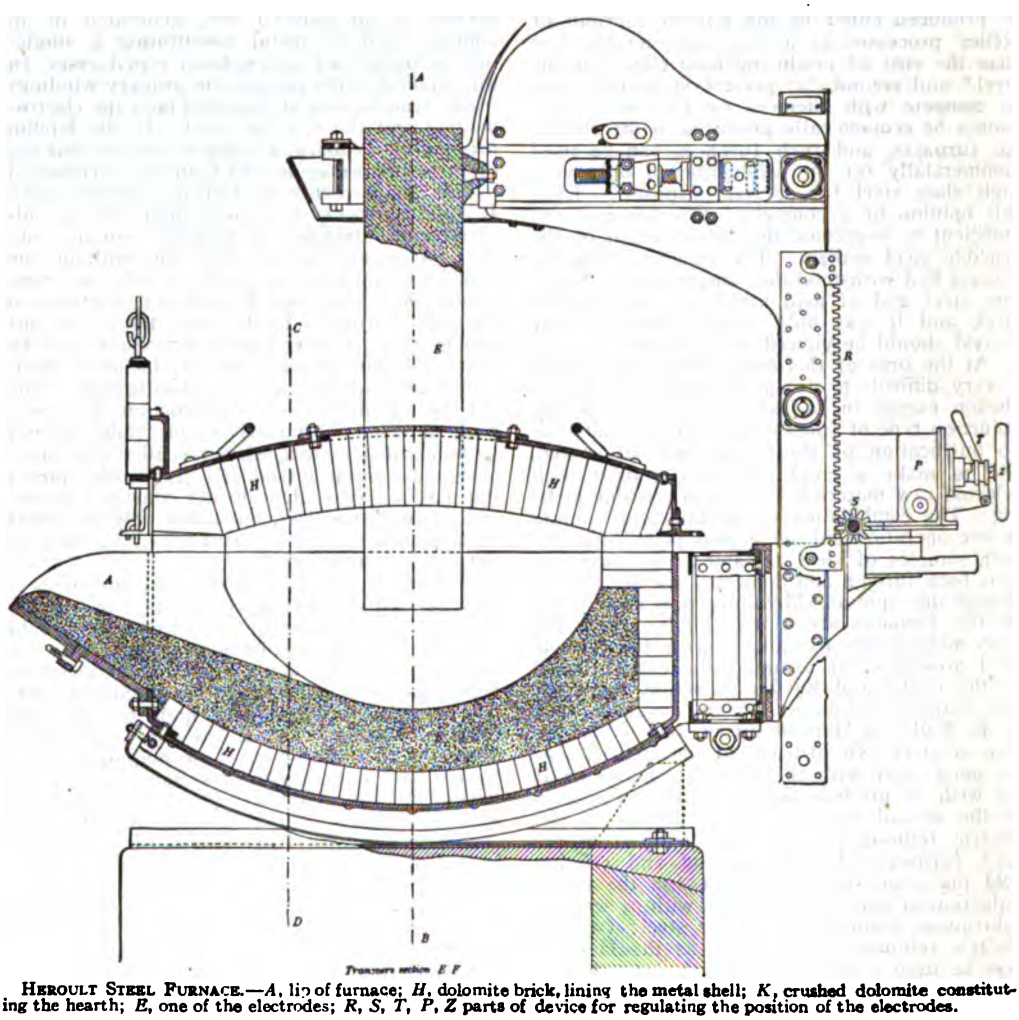
STEEL, ELECTRICAL PROCESSES OF MANUFACTURE. Electrometallurgical processes for the manufacture of pig iron, steel and ferro-alloys, have received profound attention from a commercial point of view during the years of this century. In fact, a commercial production of electric steels seems to coincide almost exactly with the opening of the 20th century, for we have it as a matter of record that three days before its beginning Heroult delivered to Messrs. Schneider and Company, Creusot, France, a carload of electric steel bars. This is the first record we have of a commercial sale and delivery of such steel. Experiments were made and basic patents covering different processes were taken out during the closing years of the 19th century. It is over 40 years, however, since Sir William Siemens constructed and patented an electric arc furnace which would melt steel. It is not recorded that he believed this laboratory furnace was the beginning of the new industry, but whether he thought so or not he stated very clearly the reasons why electric furnaces should be superior to other furnaces where the product is in contact with the products of combustion of carbonaceous fuel. The advantages of electric melting as stated by Siemens are, first, the degree of temperature is theoretically unlimited; second, the fusion is effected in a perfectly neutral atmosphere; third, the operation can be carried on in a laboratory without much preparation and under the eye of the operator; fourth, the limit of heat practically obtainable with the use of ordinary refractory material is very high, because in the electric furnace the fusing material is at a higher temperature than the crucible, whereas in ordinary fusion the temperature of the crucible exceeds that of the material fused within it. In short, he says that the function of electric melting is to 'effect such reactions and decompositions as require for their accomplishment an intense degree of heat, coupled with freedom from such disturbing influences as are inseparable from a furnace worked by the combustion of carbonaceous materials.' The soundness of these conclusions as applied to commercial conditions have been amply confirmed during the past decade. It seems like the fulfilment of prophecy, for they were overlooked and all but forgotten for nearly a generation until there arose a group of engineers and inventors in several European countries during the closing years of the last century who perfected various processes for doing in the mills what Siemens had done in the laboratory. The enthusiastic claims of these inventors were not received with much interest by the steel men, but the Canadian government displayed commendable foresight when it appointed a commission in 1903 to investigate these processes at first hand in Europe, and in their report in 1904 Professor Harbord, the metallurgist of the commission, stated first «that steel equal in all respects to the best Sheffield crucible steel could be produced either by the Kjellin, Heroult or Keller processes at a cost considerably less than the cost of producing high class crucible steel,» and second, «at present structural steel, to compete with Siemens or Bessemer steel, cannot be economically produced in the electrical furnaces, and such furnaces can be used commercially for the production of only very high class steel for special purposes.» Even this opinion of a competent observer was not sufficient to overcome the conservatism of the crucible steel makers. The venerable crucible process had withstood the competition of Bessemer steel and of acid and basic open hearth steel, and it was only natural that the new arrival should be viewed with distrust.

At the time of this report the writer found it very difficult to accept Harbord's first conclusion except in so far as it applied to the induction type of furnace, in which at that time no purification of the charge was attempted, and to make a good steel one started with selected raw materials just as in crucible melting. The combination of melting and refining in one operation did not appear promising, and such samples of steel as came under examination, both foreign and domestic, did not tend to change this opinion. Metallurgically considered, electric furnaces are of two kinds. First, the early melting furnaces analogous to the crucible steel process — for example, the earlier Girod or the Colby and Kjellin induction furnaces; and second, smelting or refining furnaces, such as the Keller or Heroult furnaces for either pig iron or steel. In furnaces of the melting type we must start with the best raw materials if we wish to produce the best steel. Furnaces of the second type may be used (a) for the electric refining of pig iron direct from the blast furnace; (b) for melting and refining cold pig iron and scrap; (c) for the direct reduction of iron from its ores with or without subsequent refining to produce steel; (d) the electric refining furnace such as the Heroult, may be used as an adjunct to the open hearth or Bessemer process, in which the preliminary melting and refining is done. Electrically considered, these furnaces include (a) arc furnaces, e.g., the Stassanno process; (b) arc-resistance, e.g., Heroult steel process; (c) resistance furnaces, e.g., the Keller, Harmet and Heroult pig-iron furnaces, in all of which there is a movable carbon electrode and the hearth constitutes a fixed electrode. These furnaces are especially suited to the reduction of iron ore, the charge of ore, lime and coke constituting a resistance conductor between the movable electrode and the fixed electrode. In the Gin process a current is passed through the melt itself, making use of the Joule effect. In the Girod crucible process we have what may be called a furnace of the superficial resistance type. The current does not pass through the charge itself. The furnace consists of a crucible of refractory materials surrounded by a granular carbon resistance material to which the current is conveyed by solid carbon conductors, and the whole device is enclosed in a refractory chamber of non-conducting materials for thermal and electrical insulation; (d) the induction furnace invention is due to E. A. Colby, but Kjellin, Schneider and others employed the same principle, in that the heating current is an induced one, generated in an annular bath of metal constituting a single-turn-secondary of a step-down transformer. In the original Colby patents the primary windings of the transformer surrounded both the electromagnet and the crucible itself. In the Kjellin process the primary winding is close to one leg of the electro-magnet and both are surrounded by the single-turn-secondary or crucible itself. It would appear that there might be an advantage in dividing the primary winding into two parts, one within and one without the crucible-secondary, in other words, in combining the Colby and Kjellin constructions in the same furnace. In the limited space of this article only a few typical processes can be described illustrating some of the above-mentioned general principles of construction. The variety of details of construction are very numerous, but the underlying principles are not so numerous; in fact, while so-called new processes have been introduced frequently during the past 15 years, they do not constitute essentially new discoveries, but differ only in details of application of the electric heating and of furnace construction.

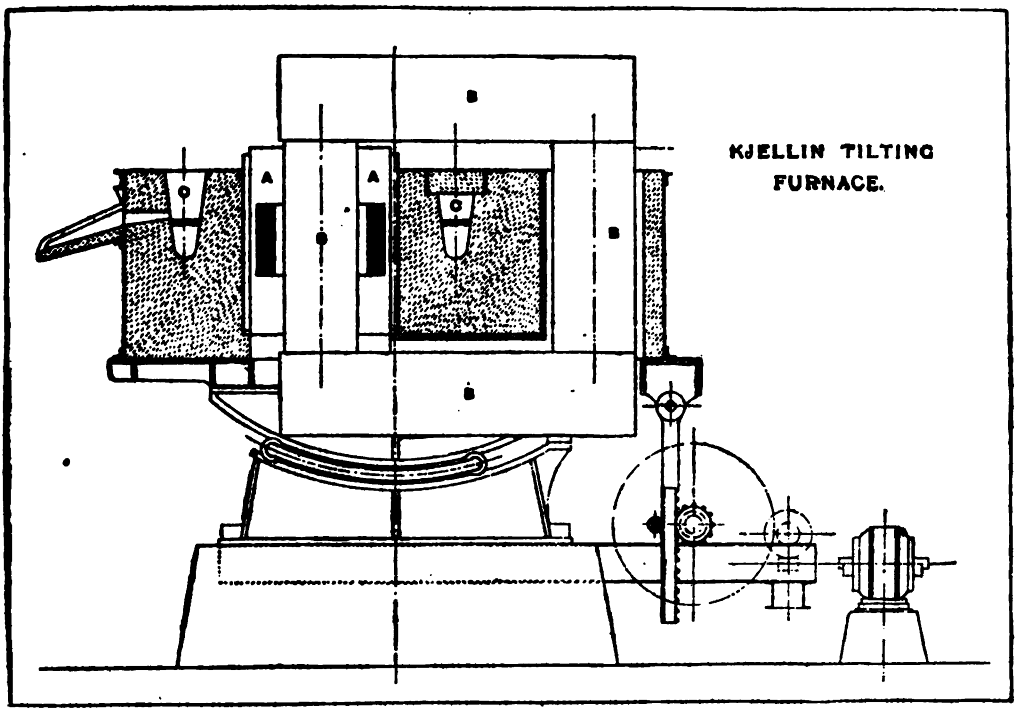
Before describing a few of the processes it may be said that in the earlier days of electric steel furnaces it was considered that they could only be installed in places most favorably located for a cheap supply of power, or in places where metallurgical fuel, such as coal and coke, was extremely scarce and high priced. The earlier furnaces were all of the single-phase type, and in the case of those employing electrodes only one or two electrodes were used. About 10 years ago three-phase furnaces with three electrodes came into use, and since that time furnaces with from four to six electrodes have been produced in the larger sizes. The cheapening of power costs in many localities has brought about a much more general introduction of these furnaces than was contemplated even by their inventors. Another early idea in regard to electric furnaces operation was that they could only be used commercially for refining material previously melted in the open hearth or the Bessemer. The first installation in the United States, which was made at the plant of the Halcomb Steel Company, was of this type, and the electric furnace, which was of four gross ton capacity, was used for refining material melted in a 20-ton basic open hearth furnace. This installation is still in use after 13 years of continuous service. An identical installation was started in Germany at almost the same time. To-day furnaces operated on cold charges are much more numerous than those employing the original duplex process, and they are located in places that formerly would have been thought unsuitable for such installations.

The Stassano Process.— In the Stassano furnace the heat is radiated from one or more pairs of large carbon electrodes placed above the charge and in the top of the furnace. The furnace is of the arc type, and, as the electrodes are not in contact with the material that is to be melted, it is plain that no impurities are introduced into the melt from the electrodes themselves. Either iron or steel may be produced, depending upon the mixture used. With the earlier furnaces of this type the hearth rotated during the operation at a small angle to the vertical, facilitating the mixture of the ingredients and the reactions taking place in them. This process is still in use in Italy with both rotating and stationary hearths. Its use has not been adopted to any very great extent in other countries, and some of the installations that were made in this country have been abandoned. It was found that the arc, placed so high above the charge, produced an excessive heating of the refractories of the roof, and that the expense for upkeep was high. The furnace is capable, however, of producing high-quality steel.



Heroult Steel Furnace.—*A*, lip of furnace; *H*, dolomite brick, lining the metal shell; *K*, crushed dolomite constituting the hearth; *E*, one of the electrodes; *R, S, T, P, Z* parts of device for regulating the position of the electrodes.

Heroult Process.—This process, as applied to the production of steel, makes use of an arc-resistance tilting furnace, usually basic lined with dolomite or magnesite. Two or more large electrodes pass through the roof of the furnace. In the single-phase furnace, such as was first used exclusively, the current passes down one of these electrodes, crosses a narrow air gap through the slag into the melt, and is then conducted back through the slag and another air gap to the second electrode. Alternating current of about 100 volts is used. The width of the air gap is automatically regulated by very ingenious devices which automatically raise or lower the electrode as the resistance in the circuit varies. Tool steel, or structural materials, and especially alloy steels, can be made by this process in this furnace either from a charge of cold materials or from a liquid charge previously melted in some other furnace. The charge may consist of miscellaneous scrap, ore and lime, and usually some fluorspar, sand and lime are used for the preparation of slags toward the end of the process. When it is desired to remove both sulphur and phosphorus from the charge it is customary to rake off the first slag formed during the melting-down period, and with it goes most of the phosphorus. The operation during this period is oxidizing. After the phosphorus slag is removed a second slag, usually known as a “carbide slag,” is formed, and under reducing conditions in the furnace the sulphur is very largely eliminated. In this particular the electric processes of several types are far superior to any other processes for removing sulphur. When such furnaces are used in conjunction with the basic open hearth furnace, the burden of dephosphorizing is borne by the basic open hearth and desulphurizing and deoxidizing only are done in the electric furnace, and the operation is carried out entirely under reducing conditions.



A, is just above the primary coil; *B*, iron core or magnetic circuit; and *C*, the bath (secondary circuit). The advantages of this furnace are that it can be tipped over the lip, or from the taphole, and can easily be repaired and relined when necessary.

Colby and Kjellin Processes.—The inventor of the induction furnace was Mr. Edward A. Colby, an American. It does not appear, however, that at the time of taking out his patents in 1890 he had any idea that the process might be used on a large scale for steel melting. Ten years later Kjellin, in Sweden, employed the principle of induction to the construction of electrical furnaces for steel melting, and since the results of these later experiments have been made public Colby has also designed a furnace for similar use. The Kjellin process was put into actual service in Sweden about 1900, producing a merchantable product, mostly tool steel, and has been made the subject of many careful investigations. This process naturally attracted the attention of makers of high-grade steels as the nearest substitute for the old process of crucible melting. The furnace was studied in operation, and careful investigations of the product were made by the Canadian commission, by Dr. V. Engelhardt and by the writer, during the earlier years of its operation. The furnace, as described by Dr. Haanel, constitutes a step-down transformer. A primary coil of insulated wire is wound about one leg of the magnetic circuit. The secondary is formed by the charge in an annular groove, also surrounding the same leg of the magnetic circuit. In the original Kjellin furnace at Gysinge, Sweden, the primary alternating current is delivered at 90 volts and 3,000 amperes. The secondary current induced in the charge itself is of low potential, and the conversion of electric energy into heat takes place in the substance of the charge itself. The furnace may be either acid or basic lined, but the latter is most used, the lining constituting the annular groove or crucible, being usually made of magnesite. The furnace may be either tilting or stationary. No attempt was made at purification of the materials used, but carefully selected raw materials, well melted, gave an excellent steel, the analysis of which was nearly the mean of the constituent materials of the mixture. This, of course, is a more expensive way of producing tool steel than by refining processes, but it is the surest way, and processes depending upon refining methods can never be as certain in their results as the crucible or the induction process, in which raw materials of known impurity are employed. Larger furnaces of the induction type were later produced in Germany, in which by a special arrangement of the hearth refining was possible, but in both the simpler and these more complicated furnaces the question of repair of linings was very serious, and it can scarcely be considered that they have been a commercial success. Some very large ones were installed in this country, but it is understood that they have been abandoned as uncommercial. One electrical disadvantage is that these furnaces for best operation require a current of unusually low frequency. The modified Kjellin furnace, adapted to refining, is known as the Rochling-Rodenhauser furnace. The induction furnace can operate upon two kinds of mixtures: first, pig iron or scrap, and second, pig iron, scrap and ore briquettes.

Conclusions.— Of the many other processes two may be mentioned which employ the principle of bottom electrodes. The Girod furnace makes use of water-cooled metallic electrodes imbedded in the bottom lining of the furnace so that the current actually passes through the charge itself from top to bottom. The Greaves-Etchells furnace, a fairly modern English process, makes use of the principle of a conductive hearth itself, and no inserted electrodes are used. The entire bottom, after the furnace is once heated, becomes a resistance conductor and is supposed to produce beneficial results by heating the materials at the bottom of the charge more perfectly than can be done by an overhead arc furnace, and this advantage is supposed to be most marked in the manufacture of alloy steels, especially those of heavy metals, such as tungsten, which sink through the bath and are apt to lie on the bottom of the furnace without being entirely molten or absorbed by the charge itself. It is difficult to compare the various processes as to their efficiency. In the first place, at no one plant have all of them been tried under uniform conditions and skill of operation. There are so many variables entering into the matter that comparisons can be made only in one or more particulars. For example, the current consumption per ton of product can be readily compared, but unless the furnaces compared are operating under similar conditions, and on a similar product, the figures are quite valueless. Moreover, in melting a similar quality one furnace may require more current than another, simply because the melter refines his steel more perfectly and the kilowatts used may make the difference between well and poorly-melted steel. Other variables are the life of the roofs, bottoms, side walls and electrodes, the first cost of the furnace and the quality of construction, and, from the power-house point of view, simplicity and the cost of equipment must be considered, and this involves differences of phases, frequency, voltage and power factor. When all of these elements are considered, together with ease of operation, it is apparent that it is not simple to give off-hand judgment as to what furnace is best to use. The time is past when the electric current itself is supposed to confer any mysterious benefits upon the products, but its function is just as stated by Siemens 40 years ago. Various claims are made by inventors depending upon whether the current passes through the bath horizontally or vertically or is merely radiated to the surface. However, it should be remembered that at the temperature involved molecular mobility is very great, and solution and diffusion will take place satisfactorily if the total heat available is sufficient to maintain the entire contents of the bath perfectly fluid.

The electric processes under most careful handling are capable of producing steel approximately equal to crucible steel, but each process has its peculiar field, and while some crucible tonnage may be diverted to electric steel, yet it is more likely that electric steel will find its own market in the most exacting requirements of steel for structural and tensile properties, such as have come about almost simultaneously with the processes themselves, namely, for the automobile and airplane parts. Crucible steels for these purposes are not commercial because of the difficulty of making very low or medium carbon alloy steels in the crucible and the tonnage demand is far beyond what could be met by the crucible process. The electric furnace was apparently invented to meet a new demand rather than to replace an old process. As one writer has said, "The luxury of to-day is the necessity of to-morrow. Safety cannot be measured by price, and public opinion will more and more insistently call for the highest excellence in the automobile, the airplane and other forms of fabricated material."

There are now in use in the United States between 300 and 400 electric furnaces of various types, over half of them being of the Heroult design. There are probably as many furnaces altogether in Europe as there are in the United States. The introduction of the process was stimulated amazingly by war requirements for materials of unusually high grade, and in meeting these requirements the electric steel makers responded nobly in their contribution to the war program.

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STEEL, EVOLUTION OF STEEL-MAKING PROCESSES. In prehistoric times the earth's inhabitants fashioned their implements from flint. After a time, as the result of observation or chance, primitive men discovered that metals, such as copper and lead, could be obtained from certain earths or ores, and it was not long until they found that copper could be made harder by the addition of a little iron, arsenic or tin. That they ever actually hardened copper, in the sense that we harden steel for tools, is extremely improbable.

It is not easy to say whether the Bronze Age preceded the Iron Age or not, and if it did, by what period. Flint instruments and weapons are almost imperishable, bronze is very enduring, while iron rusts, and if buried in a damp place is wholly converted into hydrated oxide or carbonate of iron, soluble in waters containing much organic matter. For this reason iron relics of great age are scarce, while flint and bronze fill the museums. However, in certain ruins of the Swiss lake dwellings all three sorts of implements were found, flint, bronze and iron.

The use of iron is frequently mentioned in the early books of the Old Testament. The Egyptians were familiar with it at least 4,000 years ago. The Assyrians probably knew how to obtain iron from its ores and how to fashion it into saws, chisels, etc., at a still earlier date than the Egyptians. The various ages known as the Stone, Bronze and Iron ages are not fixed periods in the world's history, but are periods in the history and development of individual tribes and nations. For example, while at a period, say 1000 B.C., the Egyptians and Assyrians were making swords of iron (and a cross-cut two-handed saw of this period is in the British Museum) the Bronze Age existed in southern Europe, while in the northern and western Europe wood and stone implements were in general use. In India, China and Japan there is abundant evidence of the manufacture and use of iron at a very early period. In this very day there are tribes in central Africa which have but attained the degree of skill which we picture in our minds when the «Iron Age» is mentioned. They are making iron in a most primitive fashion and their methods may be the identical ones used thousands of years ago by the Assyrians. Their metallurgical skill is by not means slight, for they know how to smelt ores in a little cupola blown by a hand bellows, and to employ the right fluxes to obtain a product of remarkably good analysis. They use charcoal as fuel and the chunks of metal which they obtain by first smelting are sold to smiths who refine them still further by a sort of puddling process, and a tool made by this means gave, according to Bellamy and Harbord, the following excellent analysis: Carbon, 1.02; silicon, .026; sulphur, .006; phosphorus, .012; manganese, trace. There are evidences in Belgium of ancient iron workings dating from the Roman occupation, and they were famous armorers through many centuries. The skilled workmen of this country emigrated especially to England and Sweden and were the founders of the fine steel industries in those countries. Those who emigrated were the Walloon Belgians, and the exodus became so great that at one time it was stopped by law.

During the time of the Norman Conquest and the Tudors, the manufacture of iron in Great Britain was an insignificant industry, and the chief supplies were imported from Belgium, and from Belgium came the invention which gave a great impulse to the iron and steel business, viz., the invention of the blast furnace. Prior to this invention iron was produced direct from ore in a crude form of hearth, the product being wrought iron or steel, which was obtained in a solid or pasty condition far from homogeneous in composition, and when large or intricate forms were desired they were made from these crude materials by laborious welding and forging methods. With the invention of larger and improved blast furnaces by the Belgians it was found that practically a new metal, fused cast iron, was at the disposal of the early metallurgist. Cast iron was made in Sussex as early as 1350, and the art of iron founding gradually grew and flourished in England and on the Continent, until in 1543 cast-iron cannon were made in England, and in 1595 these were made as heavy as three tons each. But cast iron was not only used for foundry purposes, for it was argued that if by one application of the purifying influence of fire the crude metal had been prepared from the ores, the second application of the same agency might convert it into a malleable product, and wrought iron was subsequently produced in small fineries, and from that day to this the blast furnace has been the first step in the manufacture of iron and steel. Much of this early wrought iron was delightfully low in sulphur and some other impurities, but at that time no means were known of reducing the phosphorus, and the amount of this element present in the product was due to the chance selection of the ore. There were no chemists in those days to say whether the iron contained phosphorus or not, and practical experience with the product in use was the only way of determining the merits of ores from various sources. It was soon discovered that wrought iron by long heating in contact with carbon absorbed some of that element and was thus converted into «cemented» or «blister steel.» Blister steel when piled, welded and forged becomes «shear steel,» and if shear steel is piled, welded and forged the product is known as «double shear.» By this piling and welding operation, the carbon which is highest in the outer portions of the cemented bar becomes more uniformly distributed throughout the mass of steel. In 1781 Bergman, of Upsala, pointed out that it was carbon which determines the difference between wrought iron, steel and cast iron.

The early steel works were all located in the vicinity of great forests, for charcoal was the only fuel used. The works were also located near running streams, and water wheels were used to provide power for the blast, and for the first power hammers. There are many such still in use in Sheffield. In Queen Elizabeth's time the iron trade had become so great that the wholesale destruction of forests was stopped, and the position and number of iron works was limited by law. As the result of this legislation the iron trade languished until Dud Dudley, in 1620, or a little earlier, successfully used coal in the blast furnace. In his day 20 tons a week was a large output for a blast furnace, while to-day the output of one of the blast furnaces at Homestead is nearly 5,000 tons per week. In primitive processes, the workers took advantage of natural draft and located their furnace on a windy hillside. Later, crude bellows were made from hides and still later a blowing arrangement operated by flowing water was invented. Not much real progress could be expected from such crude devices, and one of the first applications of the steam engine of Watt was running a blowing engine at the Carron Iron Works in 1760. It was not until 1730 that it occurred to Abraham Darby and his son to treat pit coal just as his charcoal burners treated wood. His idea, needless to say, was a good one, and coke was produced, which in turn was soon successfully used in the blast furnaces, and is at the present time the principal fuel used in blast furnace practice, although a few charcoal blast furnaces remain in America and are quite common in Sweden. The next great advance in the metallurgy of iron was that of Robert Huntsman, of Sheffield, who first produced crucible steel in the year 1740. As Dr. Percy says, referring to Huntsman: «Formerly, so far as I am aware, steel was never melted and cast after its production; indeed, by the founding and casting of steel after its production its heterogeneousness is remedied, and ingots of the metal can be produced perfectly homogeneous throughout, and for the practical solution of this problem we are indebted to Robert Huntsman, of Sheffield.»

Huntsman was by trade a clockmaker, and no doubt had his troubles in attempting to make springs from the crude steel which was available in his time. It was to overcome this difficulty that he began experiments with a view to melting the cemented, or blister bar, of his day, to obtain a homogeneous product. A grandfather's clock, the pendulum rod and spring of which are supposed to have been made from the first cast steel produced by Huntsman, is still shown in Sheffield. Huntsman's chief difficulty in his investigations was to find the right kind of clay for making crucibles which would stand the intense heat of steel melting. His first crucibles were only 10 inches high, and held about 20 pounds of steel. Steel made by this process was of course expensive, and could only be used for edge tools, dies and drills, for which a great degree of hardness and fine polish was desired. The original business started by Robert Huntsman is still conducted by his lineal descendants of the fifth generation at the present time. See STEEL, MANUFACTURE OF CRUCIBLE.

The next great inventions which made for progress in the iron industry were those of Henry Cort (b. 1740; d. 1800), who first made use of grooved rolls in 1784, and in 1785 produced the dry puddling process. The invention of puddling was without doubt the foundation of Great Britain's commercial greatness during the century that followed. Prior to this time cast iron had been decarbonized in small hearths, very wasteful of fuel and labor, in which only 100 pounds could be treated at a time. Cort employed the reverberatory type of furnace, in which the metal was not in contact with the fuel, but was heated by the flame, which was caused to reverberate, or beat down from the roof of the furnace. This process permitted the use of coal instead of charcoal, and allowed the use of 250- to 500-pound charges. The story of Cort's life is a very sad one, for through a dishonest partner, who died suddenly, his patents were seized to satisfy this partner's liabilities, and Cort died in poverty in 1800. Prominent treasury officials were implicated in this unjust treatment of Cort. Quite recently Americans have erected a bronze tablet to his memory in the little church in Hampstead, in the churchyard of which his grave was located with difficulty.

The invention of the hot blast by J. B. Neilson, of Glasgow, in 1828, afforded the next great advance in the metallurgy of iron. In six months the fuel consumption per ton of product was reduced from somewhat over eight tons to a little over five tons, the blast being heated to 300° F. A few years later the blast was heated to 600° F. and the fuel consumption dropped from five and one-sixth to two and one-fourth tons. At the same time there was a great increase in output as well as decrease in fuel consumption and the production of pig iron in Scotland increased fivefold between 1830 and 1840, while the use of the hot blast became a general practice during that period. As was the case with Cort, so Neilson reaped almost no reward for his invention, although the wealth it conferred upon iron manufacturers could hardly be reckoned. The same was true of Heath, who in 1840 patented the use of manganese in steel. This conferred an incalculable benefit upon the manufacturers, but Heath died unrewarded after 15 years of litigation.

It was not until 20 years after the discovery of the value of the hot blast that Sir William Siemens introduced the system of regenerative gas firing — a system in which the waste products of combustion are employed to heat the incoming gas and air of a gas furnace or the blast of a blast furnace. The application of this principle of regenerative heating in the Cowper and Whitwell stoves effected a still further great saving in fuel in the blast furnace and at the same time increased the yield.

During more than one-half of the last century wrought and cast iron were the only materials available for structural and machine construction, boilers, engines, etc. Crucible steel owing to its high cost could not be used for any of these purposes. Such was the situation when Henry Bessemer gave to the world his wonderful invention. This was the real beginning of the modern age of steel in which we live. Prior to Bessemer's invention there is every reason to believe that William Kelly, an American, was working upon what may be called the «pneumatic process.» According to a recent magazine writer, Kelly was experimenting with this process fully 10 years before the date of Bessemer's invention and had built seven stationary converters prior to 1856. His claim of priority of invention was allowed by the United States Patent Office. Nevertheless the process is universally known to-day as the Bessemer process and indeed there can be little doubt but that Bessemer made an independent discovery of the pneumatic process. Robert Hunt and James M. Swank both agree that for priority of invention William Kelly deserves all praise. See STEEL, THE BESSEMER PROCESS.

Although the first iron furnace in America was built in 1619, in Virginia, and the first blast furnace with forced blast dates from 1714, nevertheless the iron and steel business did not assume a large magnitude in the United States until the building of the Edgar Thompson furnaces in Pittsburgh, the first of which was blown in in 1879. In these furnaces American skill showed the world how to triple the weekly output and to cut the fuel cost in two. That is, while the best English and Scotch furnaces in 1880 produced from 400 to 800 tons of pig iron per week and required two tons of coke for one ton of pig, the Edgar Thompson furnaces between 1880 and 1885 produced from 2,000 to 2,500 tons per week and used only one ton of coke to one ton of pig. The coke in some cases fell as low as 1,882 pounds per ton of output. The ore used contained about 62 per cent of iron and the volume of air reached 25,000 cubic feet per minute, at a temperature of 1,000° to 1,100° F.

While we thus see that the modern steel industry is of such recent date, yet the inventions of the processes now used mainly, viz., the Bessemer (1856) and open-hearth (1861), for making steel, were relatively of long standing, and the gradual improvements in the processes themselves, their mechanical details and costs, and the gradual education of the large users of metals to employ steel in place of wrought iron and cast iron, gradually led up to the enormous demands of the last 30 years, to which the American manufacturers have responded so energetically.

Henry Bessemer was of a distinctly inventive turn of mind and had many useful inventions to his credit before he turned his attention to steelmaking. He gave considerable attention to the manufacture of projectiles during the Crimean War. The cast iron cannon of this time were seen to be unsuitable for Bessemer's powerful projectiles and he, therefore set about producing not only the projectiles, but a better material for making large guns. After many trials and discouragements he succeeded in producing steel from cast iron by blowing air through it to oxidize the impurities. His first experiments were performed in a crucible, and this being successful his next idea was to use several crucibles fed by a common air pipe. Later he adopted a large stationary converter about three feet in diameter and seven feet high and used 700-pound charges. The results were most astonishing, for Bessemer found that by the simple method of blowing air into fluid cast iron that the highest temperature then known in the arts was produced. The first formal announcement of his invention was made at the British Association for the Advancement of Science in 1856, the title of his paper being 'The Manufacture of Malleable Iron and Steel Without Fuel.' Great excitement followed the reading of this paper and the process was tried in many parts of England, but in many cases the results were anything but satisfactory. The steel produced was red short and cold short. The cause of the trouble was soon found to lie in the use of very impure pig irons running high in sulphur and phosphorus. The first converters were lined with acid or silicious materials, and little or no sulphur or phosphorus was eliminated. As long ago as 1856 Dr. Collyer writing of the effects of phosphorus and sulphur said: «The former I consider most pernicious of all. I would suggest, with due deference, that a stream of finely pulverized anhydrate of lime be forced at a given time with the compressed air into the incandescent mass of iron. The lime having a great affinity for silica and phosphorus would form a silicate and phosphate of lime and be thrown off with the slag. By this contrivance I cannot conceive but that the phosphorus would be entirely got rid of.» Here we see the «basic Bessemer» process clearly anticipated many years before it was actually successfully worked out and adopted (1871). The irregularity mentioned above was overcome by the use of selected pig irons, low in sulphur and phosphorus, and by the important discovery of Robert Mushet, viz., the addition of manganese to the metal in the ladle after the blow. The steel in the converter after the blow is dead soft, being nearly carbonless, and contains a good deal of dissolved oxide of iron, beside rather high sulphur and phosphorus. The addition of speigeleisen or ferro-manganese corrects all of these troubles. It adds a certain amount of carbon to the steel, thereby increasing its strength and hardness; it deoxidizes the overblown metal and the residual manganese combines chemically with phosphorus and sulphur, some of the sulphide and phosphide being eliminated in the slag, and the rest being rendered relatively harmless by reason of its combining directly with the manganese. After these chemical difficulties with the process had been overcome, Bessemer and others turned their attention to the mechanical side of the question and produced the converter mounted on an axis, so that the vessel could be rotated or tipped down and the air-inlets or tuyeres could be thus brought either above or below the surface of the metal in the converter. This improvement rendered the charging or discharging of the metal much easier. Bessemer was more fortunate than all the other inventors previously mentioned in that he made a vast fortune out of his invention. As a matter of fact his invention was so complete in every way that the process stands to-day exactly as he originated it, excepting for minor details. Somewhat less than half of all the steel now produced is made in the Bessemer converters. What the invention of Bessemer steel meant to the world will be seen from a few illustrations.

Steel boiler plates were first used in 1860, and because of their much greater strength, permitted of steam pressure up to 80 pounds being used. This was a great advance in boilermaking. Three years later locomotive boilers were made of steel. But the greatest applications by far for steel were for steel rails and steel ships. The first steel rails were made in the year Bessemer steel was first described to the public. They lasted six years in a place where iron rails had to be replaced every three months. From that day to this the great bulk of steel rails has been made by the Bessemer process. In 1863 two small barges were built of steel, and a year later a steel vessel of 1,250 tons was built.

Basic Bessemer.— Many investigators tried to solve the problem of removing phosphorus in the Bessemer blow, but it was not until the early 70's that Mr. Sidney Thomas came to the conclusion that its non-removal was due to the presence of a strongly acid slag, and obviously a basic slag could not be maintained in an acid lined vessel. After many failures Thomas and his cousin, Mr. Gilchrist, discovered that a lining of lime or dolomite could be made for the converter, using silicate of soda or clay as a binding material, and that additions of lime during the blow facilitated the removal of phosphorus and that an "after-blow" was necessary.

Open Hearth.— The next great advance in the metallurgy of steel was the development of the open-hearth process. (See STEEL, OPEN HEARTH MANUFACTURE). The prior discovery which led up to the open-hearth process was the invention of the regenerative furnace by Sir W. Siemens. William Siemens, a German by birth, had both a technical school and university education. His first visit to England was in 1843 for the purpose of introducing a process of electroplating, by means of which silver was deposited with a bright, smooth surface, rather than in the form of a crystalline deposit. The following year, 1844, he returned again to England and resided during the 40 more years of his useful life.

Siemens, profoundly impressed by the theory of the conservation of energy and with Joule's determination of the mechanical equivalent of heat, was ultimately led to the great discovery of the regenerative gas furnace. Then Siemens invented his gas producer, and with economical gas fuel the regenerative gas furnace was a great success. The first furnace on a commercial scale was used for glass melting in 1861, and a little later it was used for zinc distillation, heating and puddling furnaces, and for melting crucible steel. In this latter application it is used exclusively in America, while in England coke fires are still used for melting crucible steel. These are very wasteful of fuel, and possess not one single advantage over the Siemens producer and regenerative gas crucible melting furnace.

Siemens was not very successful in applying his invention to steel melting on the hearth of the furnace itself, and it was several years before any degree of success was attained in England,, but meanwhile Messrs. P. and E. Martin, in France, taking Siemens' own drawings, erected a furnace in France and overcame the obstacles that had almost proved too much for Siemens. Thus originated the Siemens-Martin process, as it is universally known abroad; while in America it is usually merely designated as the open-hearth process.

Martin produced his steel from wrought iron scrap dissolved in cast iron on the hearth of Siemens' furnace, with the necessary recarbonization at the end of the process and the addition of manganese. This method is known as the "pig and scrap" method. Siemens meantime was working on a method now known as the "pig and ore" method, in which pig iron is decarbonized by the addition of ore, while scrap may or may not be used. It was not until 1868 that the open-hearth process became an assured success.

As with the case of the Bessemer process, so with the Siemens-Martin, the acid process was the first to be employed. In fact Acid Bessemer and Acid Open-Hearth steel both antedate the basic Bessemer. Thomas and Gilchrist, who perfected the basic Bessemer process, also realized that the essential change necessary to dephosphorize was to substitute a basic lined furnace for the acid lining which had been previously used, and the maintenance of a basic slag during the operation by the use of lime.

Thomas announced the success of his experiments in 1878 before the Iron and Steel Institute, and although he announced that he had succeeded in removing from 20 to 99.9 per cent of the phosphorus from iron in the converter, and thus rendered available for steelmaking mountains of ore the world over, which without dephosphorization were useless, his announcement attracted little attention, but before many years England was besieged with German, French, American and other metallurgists, anxious to learn about the epoch-making discovery,— the basic steel process. Germany profited particularly because of the large quantities of phosphoric ores which thus became a valuable asset.

In favor of the Bessemer process we may say that when steel of from .06 to .10 per cent phosphorus is wanted it is a cheaper process than open-hearth, but low phosphorus Bessemer requires a very careful selection of raw materials. Phosphorus and sulphur must be lower in the raw materials than is desired in the steel. A disadvantage of the Bessemer process is that the steel cannot be tested during the operation. Bessemer plants are suitable where tremendous tonnages of a rather cheap product are required. The open-hearth process gives a good outlet for steel scrap, billet ends, old rails, etc. The product is more reliable than Bessemer, and the low phosphorus open-hearth steels are much cheaper than low phosphorus Bessemer. The process allows more latitude in the selection of raw materials. Low or high sulphur pig can be used and both phosphorus and sulphur can be reduced. The steel can be tested chemically and physically during the operation, and whereas in Bessemer it is customary to continue the blow until all the carbon of the pig is oxidized, in the open-hearth process the decarbonization can be checked when it has gone far enough, or when the carbon desired in the product is reached.

As regards the quality of steels made by the various methods, it is undoubtedly true that even when the analyses are almost identical that crucible steel takes first place. Next in order comes open-hearth, and last place falls to Bessemer. As regards excellence of analysis, they usually stand in the same order, crucible being finest, open-hearth next and Bessemer last. Acid open-hearth, if the proper materials are used, i.e., if virtually a crucible mixture is melted in an acid open-hearth furnace, will be a most excellent material, but as actually made, acid open-hearth is usually very high in sulphur and phosphorus and much of it resembles a Bessemer analysis. In general then basic open-hearth takes next rank to crucible because of its low phosphorus and sulphur contents. In general, of two steels of identical analysis, acid and basic open-hearth, the former will show much the higher tensile strength. Campbell has even constructed a formula for calculating tensile strength from the analysis, and in his formula it is assumed that each 1/100 per cent of carbon increases the tensile strength by 1,000 pounds in acid steel and only 770 pounds in basic. Each 1/100 per cent phosphorus exerts the same effect in either process and raises the tensile 1,000 pounds. One one-hundredth per cent manganese in low carbon acid steel raises the tensile 80 pounds and 130 pounds in basic, but the condition is reversed when the carbon is high and then the manganese raises the tensile by 400 pounds per 1/100 per cent in acid and only 250 pounds in basic. The effect of sulphur is very small.

As regards the tonnage production of steel we find that the most remarkable increase is in open-hearth steel. In 1917 the increased production of open-hearth steel over 1907 was over 200 per cent; and the total reached the impressive figure of 34,148,893 tons, or three times the production of 10 years ago.

The total production of open-hearth and Bessemer steel in 1896 was 5,250,000 tons, while in 1906 it was about 23,000,000, and in 1916 42,500,000 tons. In 1896 25 per cent of all steel produced was open-hearth and 75 per cent Bessemer, while in 1917 there was three and one-half times as much open-hearth steel made as there was Bessemer.

One must not imagine from these figures that the production of Bessemer is declining materially. The facts are that Bessemer production is about at a standstill while the gain is in the making of open-hearth steel. The basic open-hearth process has made much more rapid gains than the acid. In 1917 about one-sixteenth of the open-hearth steel was of acid manufacture. Nevertheless that was the biggest year by a considerable margin the country has ever had in the manufacture of acid steel.

Bessemer steel still holds its own to a considerable extent for rails, although open-hearth steel is making great progress in this direction and is more largely used than Bessemer for ordinary structural purposes. Of the Bessemer steel made in the United States every bit is acid. Of the acid open-hearth steel produced in the country the larger part is used in the form of castings, rather than in the manufacture of ingots for rolling.

Electric processes, which represent the latest development in the steel industry, are not an important factor yet, so far as tonnage is concerned, but they have already outstripped the production of crucible steel, and in fact in 1917 the production of electric steel was more than double that of crucible.

The total production in the United States of steel ingots and castings by all processes in 1917 exceeded 45,000,000 gross tons, which is almost exactly double the production of 10 years ago.

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STEEL, HEAT TREATMENT OF. The physical structure of steel may and does vary to a marked degree according to the heat treatment that it has undergone; and that the strength, toughness and general usefulness of a structural member of steel may be largely controlled by the way in which it is subjected to the action of heat. Formerly it was assumed that phosphorus gives brittleness, that sulphur makes the metal red-short, and that the other properties are almost entirely dependent upon the percentage of carbon present. With the introduction of the microscope and modern methods of metallography in the study of steel and other alloys, it has been found that the structure and the properties of the material may be largely modified without any change whatever in the chemical composition, and as a consequence some very practical lessons have been learned. When steel of a coarse structure, but not necessarily brittle, is heated to a certain temperature and is then allowed to cool in air, or is quenched in oil or in water, the original structure is destroyed and is replaced by one of a very fine-grained character. Pure iron, when so coarsely crystalline as to resemble cast zinc, may be restored to excellent qualities by simply heating it to a certain temperature (known as the "critical point"); its subsequent structure resembling that which it possessed when it originally left the rolls. The old idea of the process of annealing was to reheat the material to a high temperature, and then to hold it for a time at that temperature, and subsequently to cause it to cool very slowly; but later researches showed that the temperature of reheating must not exceed 1,650° F., and that the time of cooling has little or no influence upon the result. It is altogether unnecessary to reheat and reforge the specimen, and, in fact, the material is apt to be still further injured by such a process. Since almost any piece of structural steel is liable to be rendered more or less crystalline during the operations through which it is necessarily passed, it is most desirable that the process of restoration be made a regular portion of the routine of manufacture. To permit this it is only necessary that proper furnaces be designed to admit the large pieces, and to permit a uniform temperature to be maintained in all parts, reliable pyrometers being of course provided so that the correct temperature may be maintained. The operation may then be performed upon every piece as the final stage in its manufacture. The result is elimination of danger of accident from weakness by crystallization. The microscope indicates that heating at high temperatures causes a great development in the size of the crystalline grains, and that reheating to about 1,600° F. restores the original structure, or yields an even better one. A structural steel, although good in its normal rolled or forged condition, may easily deteriorate by being heated to a temperature a little above that to which steel is most commonly heated, previously to being rolled or forged. Steel that is made brittle by such heating, or dangerously brittle by exposure to considerably higher temperatures, can be completely restored to the best possible condition without remelting and without forging down to a smaller size. Practically all of the experimental results show, not only that the original good qualities of normally rolled steel can be restored after the material has been made brittle by the exceedingly simple expedient of heating to about 1,600° F. for a very short time, but also that the steel may even be made better than it was originally.

It was long ago noted that the influence of thermal treatment increases rapidly with the carbon content of steel. In one of Howe's experiments with a muffle the following variations were shown:

STEEL OF		Tensile strength per sq. in.	Elastic limit lbs. per sq. in.
0.035 carbon..........	750° C.	28,353	19,948
	1,100° C.	28,657	18,130
	1,300° C.	28,529	12,142
	1,400° C.	30,064	11,483
0.70 carbon and .68 Mn	750° C.	82,660	40,062
	1,100° C.	92,342	59,303
	1,300° C.	48,921	29,247
	1,400° C.	41,327	33,082
0.92 carbon and .240 Mn	750° C.	81,087	34,710
	1,100° C.	109,586	39,226
	1,300° C.	106,913	33,992
	1,400° C.	64,189	42,008

A yet higher carbon with less manganese yielded less tensile strength than the «0.92 carbon and .240 Mn,» but a higher elastic limit. It will be noted that generally the best result was obtained by cooling from 1,100° C. These experiments were made in a closed muffle, with both slow heating and slow cooling. The elastic limit reaches a minimum at about 720° C., then rises rapidly on heating to temperatures of 750° to 850°, and then decreases steadily. The slower the cooling the lower elastic limit is to be expected. In the matter of elongation it has been found that with 0.50 per cent of carbon, as the initial temperature (for slow cooling) is raised, the elongation decreases moderately up to 1,200° or 1,300°. With higher initial temperature the elongation decreases rapidly. In the matter of tensile strength it is noted that the increase is more marked when cooling is done in the open air than in the muffle. With rapid cooling hardness and brittleness increase, without much reference to the initial temperature of cooling, so that the steel maker always has to consider his product from several different angles. If the steel is low in carbon it will be little affected by heat treatment, but if high in carbon the heat treatment is all important.

STEEL, MANUFACTURE OF CRUCIBLE. Crucible steel is so called because the ingredients from which it is made are melted in crucibles or pots. The name to-day is almost synonymous with «tool steel»—meaning a steel containing at least one-half per cent of carbon, which will, therefore harden materially when plunged at a bright red heat into water or oil. Steel of lower carbon than this may be made in crucibles for especial purposes when hardness is not the chief quality desired. For example, steel castings are frequently made of crucible steel. The quantity actually so used in this country is only a few thousand tons per annum.

The practice of hardening steel is of great antiquity and is referred to by the early Roman and Greek writers. The ancient Egyptians heated iron, in some cases possibly of meteoric origin, in the forge until, by long contact with the fuel, it absorbed enough carbon to impart considerable surface hardening when quenched. The difference between oil and water hardening is referred to by Lucretius who says: «The finest tools are tempered in oil, which gives a more durable hardness than that imparted by water.»

The fact that iron heated in contact with carbon absorbs some of that element, which renders it harder, seems to have been known for many centuries and prior to Huntsman's invention, in 1740, all steel for tools was made by the process of cementation. Especially in Austria and England the art and industry of converting pure wrought iron into cement- or blister-bar flourished, by which, as French says: «A steel was obtained which had uncertain percentages of carbon, higher on the outside than on the inside, and varying in hardness from one end to the other, according as the bar came in contact in the converting furnace, with more or less of the carburizing material, or a higher or lower degree of heat.» It was to overcome this lack of uniformity that so-called «single» and «double-shear» were made, but Huntsman conceived the idea of melting the cemented-bar in crucibles, thus rendering it absolutely homogeneous and of uniform carbon contents throughout the mass. As first carried out, the melted steel was allowed to cool in the crucible, which was then broken away and the resulting mass was used as an ingot. About a century ago Mushet patented the production of steel made in the crucible by melting together soft bar iron and a certain amount of carbonaceous matter. This process did not amount to much until 1839, when Heath patented the use of manganese as an essential addition to crucible steel. In America the Mushet-Heath process of melting together in crucibles soft bar-iron, with or without a certain percentage of steel scrap, charcoal and oxide of manganese, spiegeleisen or ferro-manganese is more generally employed than the original Huntsman process of melting cemented or blister-bar. It has been said of Huntsman's invention that,—«The invention of cast-steel was second in importance to no previous event in the world's history, unless it may have been the invention of printing.» Huntsman's process was rapidly adopted and at the time of his death there were several firms melting steel, and possibly 500 individuals and firms making files, edge-tools, etc., in Sheffield,—famous for its «thwytles» since Chaucer's day. Among these names appeared Spencer, Jessop, Sanderson, Parkin, Turner, Hobson and Rogers and these same names appear to-day in connection with both English and American crucible steel works.

The Materials.— The base used for crucible steel is usually wrought iron. England, Germany and America draw on Sweden for the more expensive grades, and by many it is believed that Swedish materials possess some mysterious virtues not afforded by other irons, regardless of what the results of chemical analysis show. The Swedish irons are all made from charcoal pig iron and are refined by the Lancashire or Walloon processes. Some have claimed that these irons contain traces of vanadium and that to this they owe their virtue. They usually contain small amounts of manganese, while ordinary puddled irons are nearly free from this element. To the writer this seems more important than a possible trace of vanadium. A careful investigation of products made from Swedish and American irons *of the same analysis* has revealed absolutely no difference in the quality of the product, chemically, physically or by practical test in tools of divers sorts. Certain it is that rarely does Sheffield tool steel show as great purity as regards sulphur and phosphorus as is seen in the product of American mills. In America, while Swedish iron is still used to some extent, it has been replaced by selected open hearth bar and by the purer product of the puddling furnace. This commonly carries less than one-hundredth of 1 per cent of sulphur and phosphorus, and also contains much less copper than the Swedish irons.

In German and English tool-steels a combined percentage not exceeding 0.06 per cent of sulphur, phosphorus and copper is considered first class, while in America this combined percentage is about one-half as much and would not be expected to exceed 0.04 per cent in the best product.

Swedish bar or puddled bar may be and is melted directly or it may be first carburized by the cementation process. Cemented bar is used more largely abroad than in America. For the purpose of adding carbon, when the cemented bar is not used, it is customary to use either a pure Swedish charcoal pig iron or the American product known as «washed-metal.» Both carry about 4 per cent carbon and are low in sulphur and phosphorus, but the former carries rather variable quantities of silicon and manganese, from which washed metal is nearly free. This is an advantage in favor of the Swedish pig, if the silicon and manganese can be maintained fairly uniform and not excessive in amount. In some cases all the carburizing in the crucible charge is effected by means of charcoal. Small quantities of oxide of manganese or ferro-manganese are usually employed, and for special steels metallic nickel, manganese, tungsten, chromium, or molybdenum or their ferro-alloys are employed.

Crucibles.—In England, clay crucibles are almost exclusively used. They are nearly always made in connection with the works using them, the mixing usually being done by men who tread the clay with their bare feet. Little or no machinery is used in their production. The mixed ingredients are made into balls of suitable weight and these are dropped into a mold and a plug shaped like the inside of a crucible is driven in, forcing the clay up into the mold and around the plug, which is then withdrawn and the crucible removed from the mold and dried for several weeks. Before using, it is «annealed» or baked and is always filled while hot. The crucibles last only about three heats, carrying 60 pounds at the first heat and a less amount on each subsequent charge. This is because the metal attacks and weakens the crucible at the slag line and hence the level of the metal is lowered in the pot on each succeeding heat.

Graphite crucibles are generally used in Germany, Austria and the United States. These according to analysis, quoted by Howe, may contain from 20 to 83 per cent of graphite, about 50 per cent being commonly used in America. The best Ceylon graphite should be used. Artificial graphite made in electrical furnaces is unsuitable for crucibles because of its granular rather than lamellar structure. With the graphite is used either clay or a mixture of clay and old crucibles finely ground. It is also customary to use a little coke dust in making clay crucibles. Graphite crucibles are much larger than clay ones and will carry the customary 90 to 100-pound charge from 5 to 10 heats. They will stand much abuse, especially in the way of sudden changes of temperature, and need not be filled hot each time. Indeed, it is quite customary to allow them to cool off completely between heats, when they are cleaned and inspected. Graphite crucibles cost from five to eight times as much as clay crucibles, but this disadvantage is more than offset by their greater endurance and the much greater production per crucible. The disadvantage frequently mentioned, that they impart variable amounts of carbon and silicon to the steel, is more fancied than real.

Furnaces and Fuel.— Several types of furnaces have been employed for crucible steel melting, but such steel for tool purposes is nearly always melted in shaft furnaces using coke as fuel or in Siemens regenerative furnaces using gaseous fuel,— either producer or natural gas. The latter is almost exclusively used in the Pittsburgh district and seems to be the ideal fuel because of its uniformity of composition and its freedom from sulphur. In addition to these fuels, anthracite has been employed to a limited extent in a special form of shaft furnace, somewhat resembling the coke-holes or furnaces. They differ in this, however, that they require forced draft and to provide this the ash-pit is enclosed and air is driven into it and thence through the bed of anthracite on the grate by means of a fan blower. Waste heat from anthracite furnaces may be used for heating steam boilers. Petroleum has been used for fuel in the Nobel furnace for melting crucible steel for castings, as in the Mitis process. We now hear little of anthracite or petroleum for crucible steel melting, and the writer is not aware that either of these fuels is actually being used in America at the present time.

The Sheffield coke-holes or shaft-melting furnaces hold only two crucibles each, and they are not run at night. The furnace itself consists of an oval chamber about three feet deep to the grate bars and a foot and a half to two feet in section. These holes are arranged around one or more sides of the melting-house.

Their cover-bricks are just above the floor level. The melting holes are connected either to separate flues, some half dozen of them being united to form one large chimney, or else the individual flues may be united in a large common flue and stack. The draft is roughly regulated by inserting bricks in the flues. Beneath the furnaces there is always a large ash pit and cellar. In Sheffield the crucibles, after air-drying and annealing, are put into the furnace and well packed around with coke, and the materials to be melted are charged into the red hot crucible through a sheet iron funnel. The crucible rests on a stand and this in turn is supported on the grate bars. The charging being ended, a cover is placed on the crucible, the fire is urged and during the operation the coke must be replenished at least twice. Three heats from a crucible constitute a day's work and require about 12 hours' time, and three heats, also, is about the life of the crucible.

The regenerative gas furnace, which is used exclusively in the United States, has never been popular in England, although it is much more economical as regards fuel consumption. Numerous reasons have been given to explain why it is not used in Sheffield. Strangely enough it has been stated that gas fires are not under such good control as coke fires, or again, that the entire crucible and its contents are not heated to a uniform temperature. Whatever weight these objections may have, it is interesting to note that whenever English capital has been invested in the crucible steel business in America, graphite crucibles and gas-fired regenerative furnaces have been adopted without apparent hesitation.

The American furnace consists of from 2 to 10 melting holes in a row, and each hole will accommodate six crucibles at a time. Each hole is provided with three ports on either side through which the gas and air and the products of their combustion pass. The direction of flow of the gas and air is reversed about every 15 minutes, in the way common to all Siemens regenerative furnaces. Beneath and at either side of the melting holes are the regenerative chambers, one for gas and one for air on each side. The chambers are filled with so-called checker work of brick, which takes up heat from the outcoming gases or imparts it to the entering gas and air. The furnace of Dawson, Robinson and Pope, which is said to be giving very good results at Jessop and Sons, Sheffield, differs from the American furnace in that all four regenerative chambers are on the same side of the melting holes, which have four ports each. The melting hole is curved or horseshoe shaped on the side opposite the ports. The gas and air thus enter by two of the ports and rush around the curved outer edge of the furnace and down the other two ports. The six crucibles break and impede the passage of the flame and absorb its heat as it passes.

The melting holes have a layer of coke from six to eight inches deep in the bottom and on this rest the crucibles. The crucibles are usually filled carefully by hand, while cold, and are set into the furnace. The crucibles are well adapted to stand this sudden change of temperature if they have been well baked and have been kept in a dry place prior to use. Unlike the coke furnace, the gas furnace is run continuously, day and night, from Monday morning to Saturday afternoon, from 33 to 36 heats constituting a week's work. These furnaces will last from eight months to a year or even longer before the holes need relining or the checker work needs replacing. Coke furnaces require relining about once a month. The first cost of a gas furnace is much greater than that of the coke furnace, but the crucibles are more readily accessible in them and they are much more economical of fuel. A ton of ordinary bituminous coal, burned in a producer, will melt a ton of steel, while the coke shaft furnace requires about three tons of the more expensive coke to melt a ton of steel. Commenting on this phase of the subject, Harbord, the distinguished English authority, says: «The economy in fuel, ease with which gas can be regulated, freedom from clinkers on pots, offer so many advantages over the coke-hole, that notwithstanding past failures of gas furnaces, there seems every prospect of this or some similar gas-fired furnace being very largely adopted in crucible steel melting.» By the «past failure of gas furnaces» Professor Harbord must refer to their failure of general adoption in England rather than in any real difficulty with the gas furnace itself as compared with coke-holes or other furnaces. More crucible steel is melted in gas furnaces than in all other forms combined.

Melting.— The materials being charged into crucible the fire is urged in the case of coke or more gas is turned on in the case of Siemens furnaces, until at the end of about two or three hours the materials are melted. In the case of mixtures consisting of much high carbon scrap, pig iron or cemented bar the melting takes place more quickly than with mixtures consisting largely of puddled iron and charcoal. When the melter thinks the contents are about melted, the cover of the crucible is raised and the contents examined by the melter who prods about in the crucible with a long iron rod to detect unmelted pieces. The melting of large pieces of steel scrap takes place in a rather unexpected fashion,— the inside seems to melt first and to run out, leaving a shell looking exactly like the original piece, floating around on top of the metal.

After the materials are «clear melted,» the heating is continued for an extra half hour or more and this is known as the «killing» heat. If the metal were poured into the ingot molds immediately after melting, unsound and spongy ingots would result. During the killing some silicon is taken up from the walls of the crucible by the metal and this seems to assist in making sound castings. Then, also, the oxide of iron which is present in the metal has a chance to react with the carbon in the steel or in the walls of the pot and is thus reduced to metallic iron, while oxides of carbon are formed and eliminated. Steel that has been given sufficient killing, if cast in open molds and allowed to cool spontaneously, would be quite free from blow holes, but would be deeply piped. In actual practice means are employed to eliminate the pipe, and the ingots are perfectly sound from top to bottom. The tendency to eliminate gas during solidification is offset in varying degree by silicon, manganese and aluminum.

The Ingots.—The crucibles, after the killing heat, are withdrawn from the furnaces and

STEEL INDUSTRY

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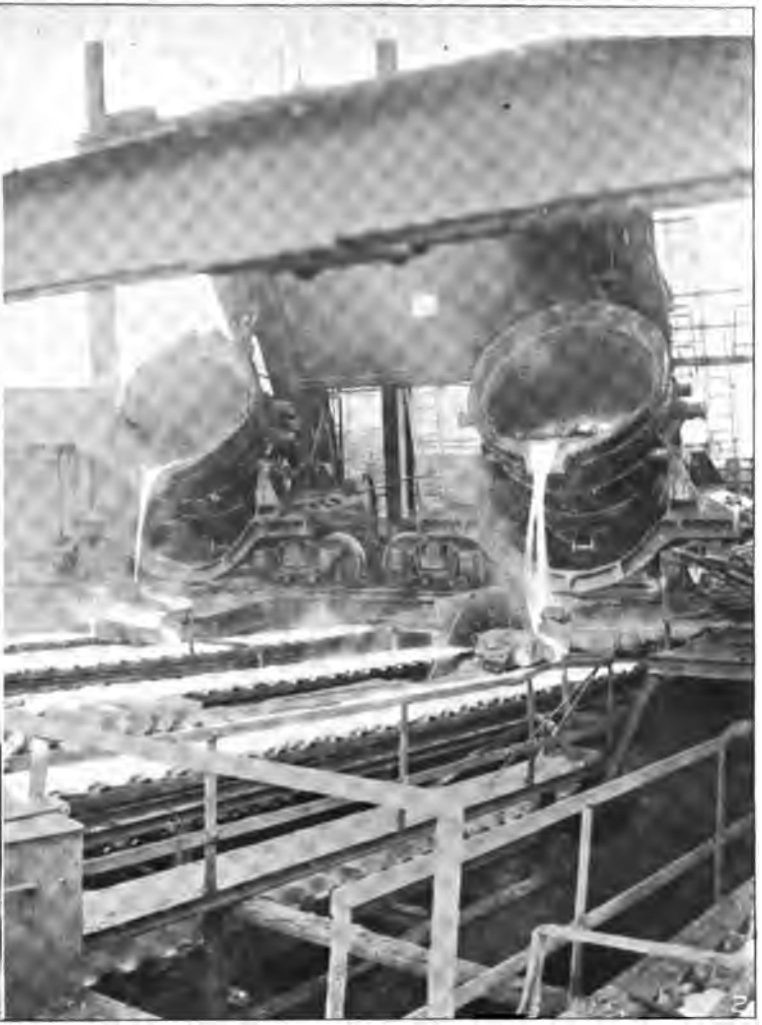
1 Taking ore from huge bins to the blast furnaces in a Pennsylvania steel mill. The ore is first converted into pig iron, then into steel



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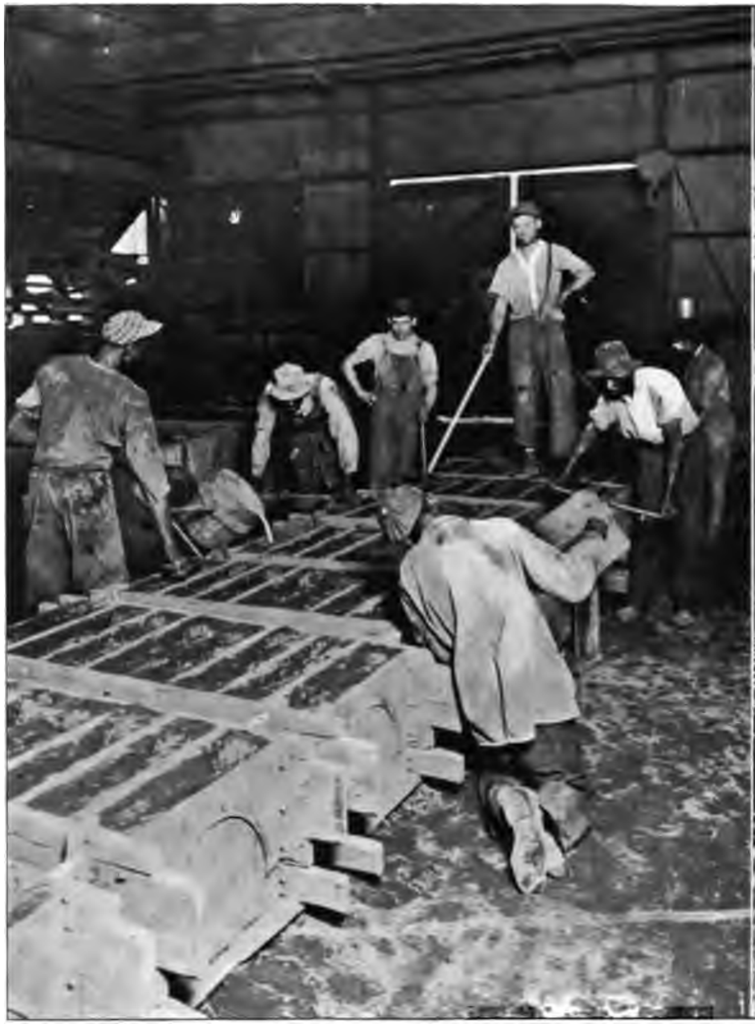
2 Huge ladles pouring molten iron into pig molds on conveyer belts, Pittsburgh

STEEL INDUSTRY



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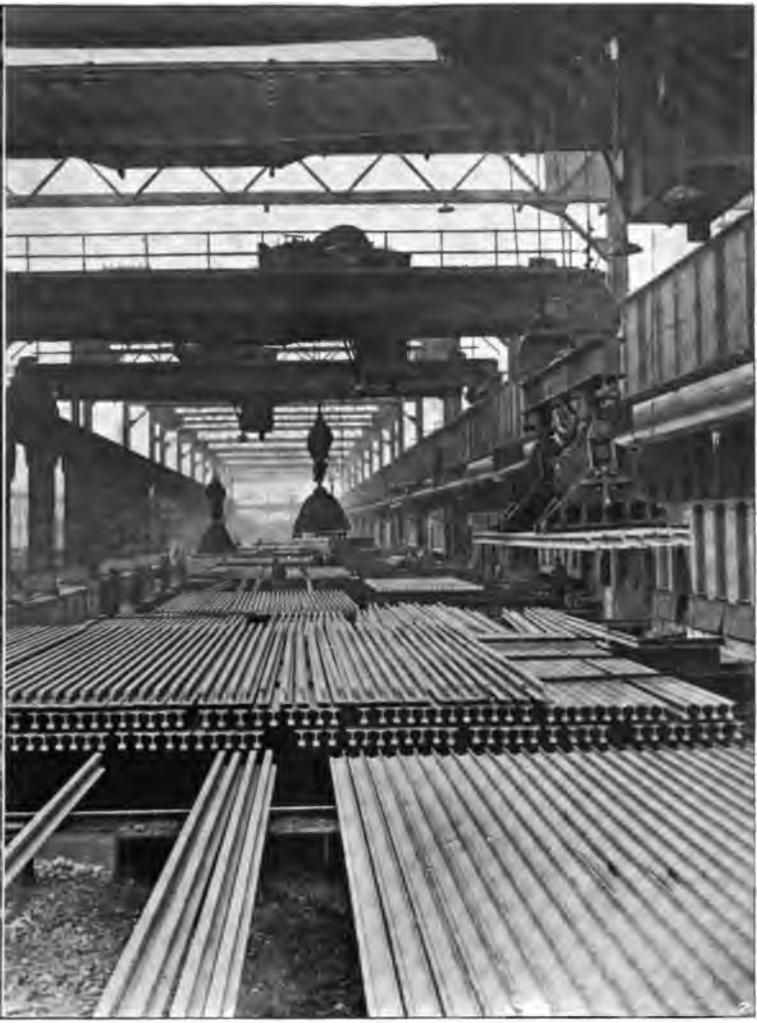
1 Making pipe molds in the great steel plant at Encloy, near Birmingham, Ala.



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2 Huge electric magnets stacking street rails at one of the big mills near Pittsburgh

the small quantity of flux or slag always present is "mopped" off. The metal is then poured or "teemed" into molds. The molds are of cast iron and usually in two parts, held together by rings and wedges. Before use, the molds are smoked with resin. When it is desired to make large ingots, the product of any number of crucibles is cast into one mold. Until quite recent years large castings for ordnance, armor and projectiles were made of crucible steel. The Krupp works continued this practice longer than the leading English and American works. Crucible steel ingots weighing 30 tons and above and requiring over 1,000 crucibles of metal have been made. It is now 25 years since the general use of crucible steel for heavy ordnance, shafting, cranks, etc., ceased, though some is still used for these requirements.

Grading the Ingots.— The quality of steel depends upon the method of manufacture, the analysis and the method of handling. Even when of almost identical analysis, crucible steel takes first rank for quality with electric steel a very close second, open-hearth steel stands third and to Bessemer must be assigned last place. The exact reason why this is so is not known definitely, but the fact is generally admitted. The quality of crucible steel depends upon the nature of the raw materials entering into the crucible mixture. In general, the lower the percentages of sulphur and phosphorus the better the steel, and the higher the carbon the more pernicious is the effect of these unwelcome metalloids. The degree of carburization is generally referred to as the "temper" of an ingot. In a works making hundreds or even thousands of small ingots per day it would manifestly be impossible to analyze each ingot for carbon. Fortunately, this is not necessary. Very small differences in carbon so change the fracture or crystallization of the ingot that the skilled inspector can detect by the eye differences of carbon not greater than one-twentieth of 1 per cent, within the limits of carbon most used for tool steel, say, 0.90 per cent to 1.40 per cent carbon. The presence of large amounts of tungsten, chromium, molybdenum and other alloying metals interferes with or precludes entirely the estimation of carbon by the eye. Other elements being within the usual limits, e.g., silicon and manganese from 0.10 per cent to 0.25 per cent and sulphur and phosphorus from 0.01 to 0.025 per cent the percentage of carbon is the most important factor in determining the suitability of any steel for a given purpose. According to Thallner, steel containing upward of 1.5 per cent carbon may be called very hard and is suitable for turning and planing knives, drills, razors, etc. Hard steel of 1.25 per cent carbon is suited for ordinary turning and planing knives for use on materials of medium hardness, also for rock drills, scrapers, cutters, etc. Medium hard steel of 1.0 per cent carbon is suitable for screw taps, coining dies, chisels, punches, etc. Thallner calls steel of 0.85 per cent carbon tenaciously hard, and recommends it for screw-taps, cutters, broaches, matrices, swages, pins, bearings, chisels, gouges, etc. Steel of 0.75 per cent carbon is tough and suited to tools requiring rough handling, hammers, shear blades, drifts, springs, cupping tools and certain kinds of needles. Soft tool steel is rather a misnomer, but the term is used in a relative sense, and applied to steel of about 0.65 per cent carbon, for blacksmith's tools, bolts and for welding to harder steel to stiffen and toughen it. No arbitrary list of this kind can fit all cases. In general, the crucible steel business is one involving a tremendous amount of detail, care and watchfulness. The temperature of the metal must be carefully guarded and controlled at every step — melting, welding, cogging, rolling or hammering, and when the steel reaches the customer equal care is required to forge, to harden and to temper the finished tool. The proper selection and blending of raw materials or the choice of the proper quality and carbon for a given use, and its successful fabrication may not be learned from books or acquired in a day, but are a legitimate part of the stock in trade of Böhler, in Styria; Jessop or Huntsman, in England; Sanderson or Halcomb, in America, and other firms with established reputations.

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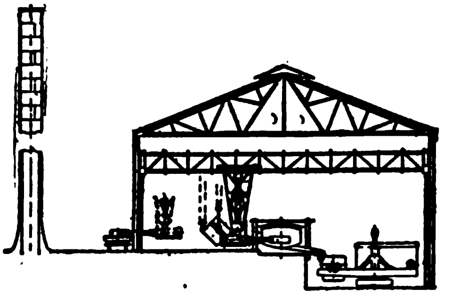
STEEL, OPEN HEARTH MANUFACTURE. The process of producing steel of this class derives its name from the type of furnace used — an open hearth. In European practice the process is known as the Siemens-Martin, receiving its name because of being originated, developed and perfected by two eminent and early metallurgists (1864–67). The process is conducted either in an acid or basic furnace depending upon the character of the raw material treated.

There are several divisions of the process. The original plan was to treat a charge of all pig-iron with the assistance of iron ore to convert into steel. Later a modification was introduced wherein pig-iron and steel or wrought-iron scrap were melted together and subsequently refined to steel. The first named constituted the Siemens process and the second the Siemens-Martin. To-day the essentials of both processes remain, but modifications have been introduced from time to time. The Monell process, conducted in an open hearth furnace with a basic lining, consists of a charge of molten pig-iron to which certain quantities of iron ore and lime are added which fuse to form a slag and which slag flows out of the furnace at a point above the surface of the molten metal, thus carrying with it certain impurities in the charge of metal it is desired to remove. The ore and lime are added at certain intervals to make the overflow of slag continuous until the desired stage of purification is reached.

Next in importance is the Talbot process, also conducted in a basic lined open hearth steel furnace. The furnace for this process is of movable type and is so constructed that the body can be tilted forward to discharge the bath of metal through an opening placed at the level of the bath, or it can be moved in the opposite direction to pour out of suitable openings placed at a higher point greater or less quantities of the slag. The process is a continuous one. A full charge of metal — about 200 tons — which may consist of molten pig-iron direct from the blast furnace, or a mixture of pig-iron and steel scrap is treated by additions of iron ore and lime until proper pre-determined conditions are reached by slag action. At that stage the bulk of the slag is poured off and about one-third of the refined charge is withdrawn into a ladle allowing the balance to remain in the furnace. The steel in the ladle is recarburized and teemed into the ingot molds and an additional charge of impure molten pig-iron is poured into the furnace in sufficient quantity to bring the contents up to the initial charge. The remaining slag is then removed by tilting the furnace, a fresh slag made by ore and lime and the refining operation repeated. In the second treatment, however, the interval of time is considerably reduced because the residue of refined metal from the initial charge greatly dilutes the succeeding addition of molten impure stock and so making a smaller total of objectionable elements to remove by slag action. Under normal conditions the furnace is never empty excepting at week ends when incidental repairs are made. In Siemens-Martin open-hearth practice the furnace is emptied completely at the end of each heat. It is then patched up, as may be necessary and recharged.

Another process of recognized importance is the Bertrand-Thiel process. It is used in Europe to some extent. Two open-hearth furnaces are used, one acid lined and another basic. One furnace may be placed at a higher level than the other so that the charge treated in the upper furnace can be tapped directly by gravity into the one below. Or the furnaces may be placed at the same level and the charge transference from one to the other be accomplished by ladles. In the Hoesch modification of this process only one furnace is employed, the metal being temporarily transferred to a ladle while the basic lining is being spread, when it is returned for final treatment The principle of the process is that a charge of impure stock is first treated in an acid-lined furnace to greatly lessen by nearly full removal certain elements objectionable to further purification by the basic process, by which the metal is treated and fully refined in the second stage of the process. It is a combined acid and basic process whereby pig-iron is converted to steel and allows the use of stock so high in phosphorus and sulphur that it could not be successfully refined by either process singly. In the acid-lined furnace the charge of molten metal is desiliconized and partly decarburized, but not desulphurized or dephosphorized, but when transferred after such treatment to a basic-lined furnace, either by gravity or ladle, the decarbonization, desulphurization and dephosphorization are completed to meet any requirements. In the United States and Canada the Bertrand-Thiel process has, to some extent, been modified by the introduction of the Duplex process, in which an acid Bessemer converter replaces the acid open-hearth furnace, the Bessemerizing effecting the same action practically in regard to silicon and carbon removal from the charge which is subsequently transferred to a basic open-hearth furnace for removal of the phosphorus and sulphur and further purification.



ELEVATION THROUGH OPEN HEARTH FURNACE, SHOWING CHARGER AND LOCOMOTIVE CASTING CRANE.

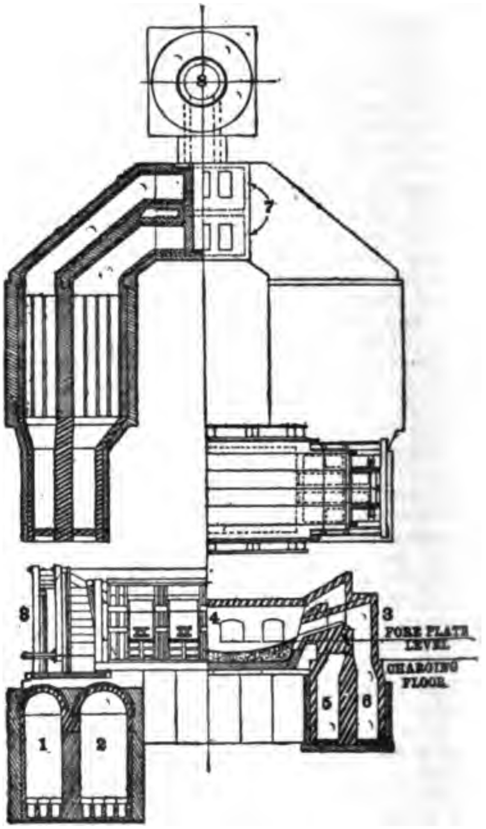


FIG. 1.— PLAN AND ELEVATION OF OPEN HEARTH FURNACE DESIGNED FOR BURNING PRODUCER GAS. — (1) Gas chamber; (2) air chamber; (3) ports; (4) melting chamber; (5) air up take; (6) gas up take; (7) base of reversing valves; (8) stack.

Construction of Furnaces.— The furnace is built on the regenerative principle. The waste heat of the spent gases from fuel consumption being absorbed and stored in the walls

Tapping open hearth

and partitions of chambers placed below the furnace body and at each end of it, can be utilized for preheating the air necessary to promote complete combustion of the fuel. Without such preheating it is not possible to depend upon flame temperature alone for melting and preserving the desired fluidity of the charge.

Reference to Figs. 1 and 2 will outline the general form of a stationary open-hearth furnace. The furnace body or melting chamber is lined with high-grade refractory bricks. The whole is braced and supported by girders, tie rods and plates. In an open-hearth furnace for the production of acid steel, the roof, hearth sides and end walls are constructed of silica bricks. The roof is very thin and of the purest silica bricks set with a little lime. It is arched and suspended from above so as not to weigh upon the side walls. The regeneration chambers are lined with fire bricks. The bottom of the hearth is lined with 18 to 24 inches in depth of fire brick over which is spread about half an inch of silica sand, the surface being dished or so formed that the metal when leaving the furnace through the tapping hole will flow and drain toward it. When a new furnace is ready to receive a charge the gradual preliminary heating up is of sufficient degree to harden the sand by slight fusion or sintering so that the hearth will preserve its shape and not be broken down by rough usage or attrition when receiving a charge of stock. In a furnace for the manufacture of basic steel, the roof walls, sides and end walls above the slag line are formed of silica bricks, but the hearth is lined in the pan with first quality fire-brick followed by bricks composed of magnesite, and at the junction of the silica bricks and the magnesite a neutral parting of chrome ore is placed to prevent fusion of the two kinds of bricks at furnace-working temperatures. The upper courses of magnesite bricks will stand about 6" to 8" above the slag line. In other particulars of brick-work the construction is the same in both classes of furnaces.

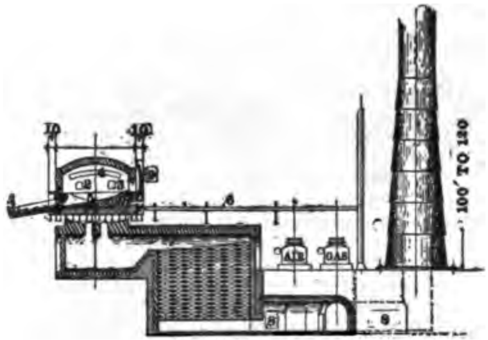


Fig. 2.—Sectional Elevation of Open Hearth Furnace. (1) Spout; (2) gas port; (3) gas port; (4) air port; (5) hearth lining, sand for acid melting, magnesite for basic melting; (6) charging platform; (7) regenerator chambers with checkers — dark markings spaces between bricks; (8) flues leading to stack and from gas and air valves; (9) charging door; (10) buckstays and tie rods.

The various dimensions, areas and volumes of body, down-takes and regenerator chambers vary mainly with the capacity of the furnace in regard to tons per heat or operation. The width of the furnace is usually between 12 and 15 feet and does not exceed 16 feet. The length and depth of hearth are not fixed, but the area of both closely follows certain values per ton. The length and depth of regenerator chambers will vary also, but the volumes as a rule closely follow standard figures per ton. Generally stated the following cover the various dimensions, etc.:

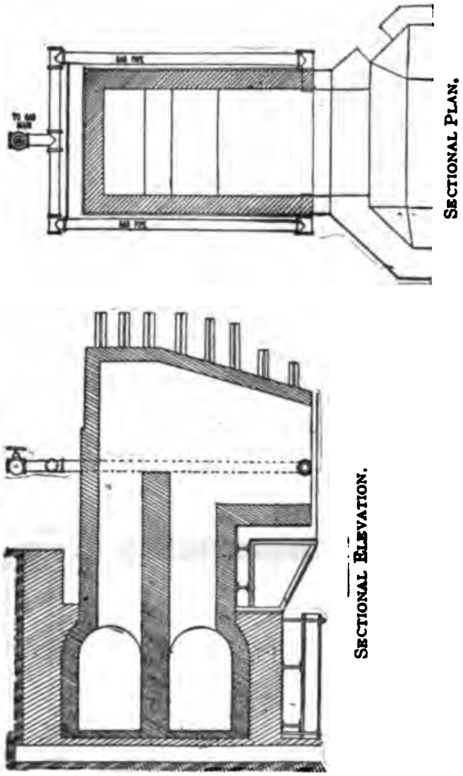


Fig. 3.—Arrangement of Furnace Port for Burning Natural Gas.

Hearth area, 9 sq. ft. per ton.
Chamber volume, 90 cu. ft. (⅓ for gas, ⅔ for air, per ton.)
Air port area, 16 sq. ft.
Gas port area, 7½ sq. ft.
Stack, diameter 4-5 ft., 100'-160' height.
Producer area, 3½ sq. ft. per ton.

Fuel.
Coal, 700 to 1,000 lbs. per ton.
Natural gas, 800 to 1,000 cu. ft. per ton.
Oil, 60 to 100 gals. per ton.

The following figures represent hearth measurements for representative capacities:

Capacity	Length x Width	Hearth Area
30 tons	27 x 10 ft.	270 sq. ft.
50 tons	34 x 13 ft.	438 sq. ft.
200 tons	40 x 16 ft.	640 sq. ft.

The last item covers the dimensions of a Talbot furnace which has a deeper bath than other furnaces. The depth of bath varies from 12 inches for a very small furnace (5 to 15 tons) to 24 inches for a 50-ton furnace. The Talbot bath is over 36 inches deep.

Fuel and Accessories.— The choice of fuel varies with the location of plants. In and around Pittsburgh natural gas is extensively used and is really the ideal fuel. It is not passed through the regenerator chambers but is fed directly into the furnace port (Fig. 3). It is uniform in composition, possesses the highest calorific value and does not contaminate the bath. Next in heating value is crude petroleum or residuum, a by-product in the distillation of petroleum. Both have advantages in uniformity of composition and ease of control. Oil is pumped, under pressure, from storage tanks delivered to a suitable oil-burning device where it is atomized by compressed air or steam before ignition in the furnace (Figs. 4 and 5). The next preferable source of fuel is the gas producer (Fig. 6). In this apparatus bituminous coal is gasified and the gaseous matter conveyed through mains controlled by regulating valves (Fig. 7) before entering the regenerator chambers. The principle of operation is to force through a mass of incandescent carbon air and steam. On top of the glowing coals fresh fuel is regularly fed to keep the bed at a constant level. The bed must be frequently poked to prevent holes forming, allowing air and steam to pass through un-decomposed. The bottom of the producer rests in a tank of water to prevent too much air from entering, since the air necessary to form a good working gas must be under control by compelling it to pass through the blower. The gas is apt to vary in composition and is not always constant in volume. A ton of coal treated in a producer will give about 160,000 cubic feet of gas. The average composition is as follows:

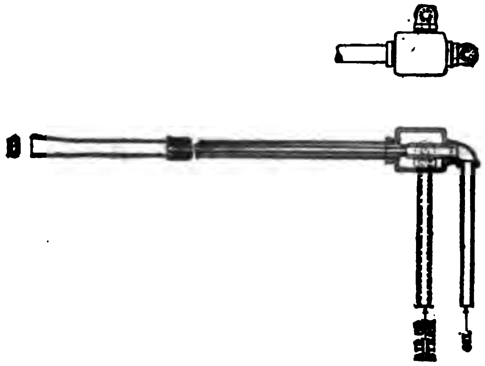


Fig. 4. — Oil Burner for Open Hearth Furnaces.

Carbon Monoxide	27 per cent by volume
Carbon Di-Oxide	5 per cent by volume
Hydrogen	10 per cent by volume
Nitrogen, etc., by diff.	58 per cent by volume

CALORIFIC VALUE OF FUELS.

	Per cu. ft.
Natural Gas	900 to 1000 B. T. U.
Oil	16-1700 B. T. U. lb. or 913.760 B. T. U.
Producer Gas	130 to 140 B. T. U.

Furnace Operation — Acid Practice.— In order to produce steel by any open-hearth process it is necessary that a certain amount of carbon be introduced with the metal to be converted. For that reason ordinary pig-iron which will contain 2.5 to 3.5 per cent of total carbon is required. The presence of carbon lowers the fusing point of iron and when charged in an open-hearth furnace it is comparatively easy to liquify the bath at an early stage of the process and maintain it to the end of the operation. Low-carbon stock, such as steel or wrought-iron scrap, cannot be used singly because if exposed to flame action it would not fuse, but would be pasty and viscous, causing loss. The charge may be all pig-iron or a mixture of 20 per cent pig-iron and 80 per cent scrap. The usual American practice is 50 per cent of each.

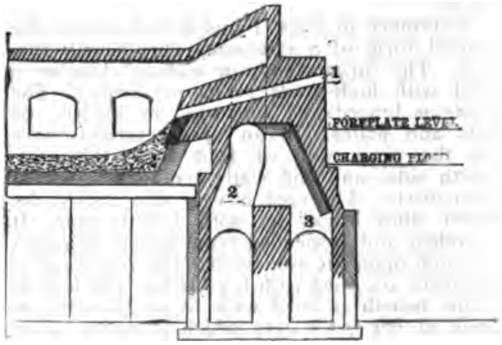


Fig. 5.— Construction for Oil Burning Open Hearth Furnace. (Half Section at Centre).— (1) Opening for oil burner; (2) air port from regenerator chamber; (3) air port from regenerator chamber.

The acid process is so-called from the character of the hearth lining which is formed of nearly pure silica sand, a substance, chemically an «acid.» It is fairly refractory but must carry a small percentage of foreign elements to very slightly lower its fusing point. In forming the hearth, as has been mentioned, it must be hard to resist wear and at the same time be inert under strong actions within the bath of molten metal at high temperature. It has no affinity for sulphur and phosphorus, but will fuse with oxides of iron or manganese. For the latter reason care is taken with heat manipulation to prevent scorification of hearth by such oxides. Since specifications for finished material, such as boiler plates, structural material, etc., state that the sulphur and phosphorus be kept below certain limits, the choice of raw material in regard to those elements is also subject to limits, and because of non-removal, in refining, whatever sulphur and phosphorus may be present in the initial charge will appear in the finished product in like proportions.

Raw material for acid treatment is called «Acid Stock,» and the following will represent average analysis:

Scrap Steel.— Sulphur, 0.04% or less; phosphorus, 0.04% or less.

Pig Iron.— Carbon, 2.-3.5%; silicon, 0.50-1.5%; sulphur, 0.04% or less; phosphorus, 0.04% or less; manganese, 0.50-.75%.

The figures on carbon, silicon and manganese for scrap are not specified, because the scrap is always the result of some previous converting process and is, therefore, low in those elements. The shapes may be ingots, blooms, steel castings, tires, springs and rolling-mill waste. If scrap composes part of the charge it will be put in the furnace first followed by either molten pig-iron brought in a ladle direct from the blast furnace or iron in the forms of pigs. Before the iron addition some little time is allowed for the scrap to heat or partly melt. The chemical action is mainly a decarbonizing one or rather an oxidizing one. The first elements to oxidize are silicon and manganese of the charge forming respectively silica (SiO_2) and manganese oxide (MnO) which fuse readily and unite to form part of the slag. The slag is mainly composed of SiO_2 and FeO. The FeO (ferrous oxide) being formed mainly in the melting of the scrap and the silica from sand carried in mechanically with the pig-iron and the oxidization of the silicon in the metals charged. The following analysis represents a normal acid open-hearth slag:

SiO	52.00 per cent.
MnO_2	17.50 per cent.
FeO	28.50 per cent.

Under flame action the temperature of the bath is gradually increased mainly because the heat stored in the regenerator chambers and radiated to the air passing through them to support flame or fuel combustion increases the efficiency. The checkers nearly fill both sets of chambers and are formed of first quality fire bricks so placed that numerous passages three to three and one-half inches square are formed both vertically and horizontally, thus offering very large areas for the waste gases to pass through and give up their heat to the numerous bricks. The temperature at which the furnace is operated ranges from 1600° to 1700° C. (2912° to 3092° F.). The waste gases leaving the furnace body are about 1100° to 1650° C. and after passing through the chambers should normally measure about 500° to 600° C. at the stack. At regular periods the course of the flame and gases are reversed so that while one set of chambers are giving up heat to the inflowing air or gas (producer only) the other is absorbing the heat from waste products of combustion. Without a careful regulation of fuel there would be danger of melting the brickwork in the furnace because with each reversal there is a constant increment of temperature carried into the furnace melting chamber.

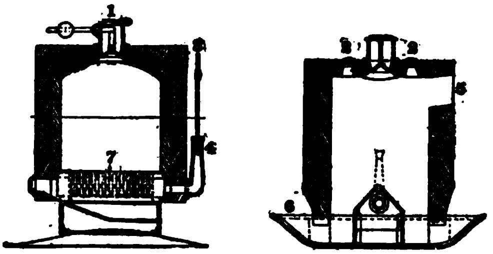


FIG. 6. — GAS PRODUCER.—(1) Coal hopper; (2) poke holes; (3) steam pipe; (4) blower; (5) connection with gas main; (6) water seated ash pan; (7) grate.

The bath under increased temperature becomes very liquid both in regard to the metal and slag. There is a lively action caused by the burning of the carbon and silicon which draws upon the oxygen in the slag and oxides dissolved in the metal. To hasten the removal of carbon, iron ore is added from time to time which produces the following reaction:

Carbon		Iron Ore		Carbon dioxide		Iron
6 C.	+	2 Fe_2O_3	=	3 CO_2	+	4 Fe.
			or			
(1) C.	+	Fe_2O_3	=	CO.	+	2 FeO
(2) FeO	+	C.	=	CO.	+	Fe.

The reduced metallic iron entering the bath, adding to the yield of metal while the gaseous carbon bubbling through the bath keeps it moving and so promotes homogeneity, an advantage in favor of any open-hearth process. When the carbon removal has been completed or has proceeded to any desired point, as indicated by the fractured appearance of test pieces taken at intervals, the metal is tapped out of the furnace by breaking open with an iron bar the tapping hole previously closed, before charging with some suitable refractory material. While the metal is flowing into a preheated clay-lined ladle measured quantities of either spiegeleisen or ferro-manganese are added which have a cleansing effect upon the steel and performs the function of recarburizing it. They are alloys of iron and manganese each carrying respectively 20 per cent and 80 per cent of manganese with about 5.5 to 6.0 per cent of carbon. It is possible to stop the refining process at any stage, and by using varying quantities of the substances just named known as deoxidizers or recarburizers, there is offered a possibility of producing numerous grades of steel. Without any additions of manganese at the end of an open-hearth operation the metal would be charged with oxides which would interfere with its rolling properties. The action of manganese is to liberate such oxides by making them readily fusible, when they float upward and mingle with the slag above the metal. Metal not well deoxidized is likely to

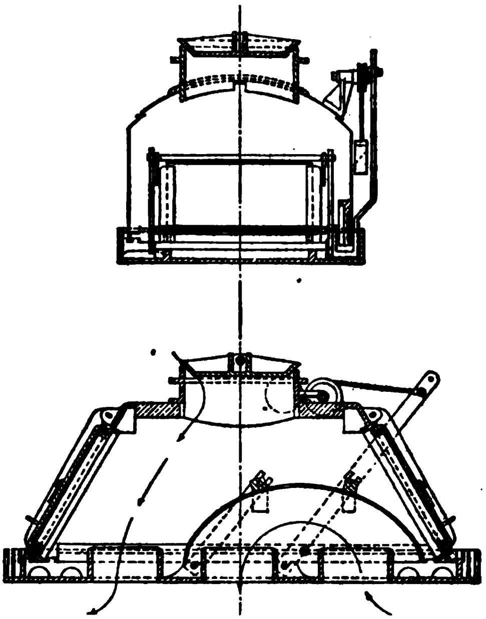


FIG. 7. — PORTER REVERSING VALVE.

Arrows show direction of intake and outgoing gases. Arrow to left indicates: "To furnace through regenerator chambers." Arrows to right indicate: "From furnace through regenerator chambers to stack."

crumble or crack when forged, rolled, hammered or welded.

After the steel is tapped into the ladle and from that into ingot molds (Fig. 8) they are stripped therefrom when the metal has solidified and the ingots are reheated and rolled out into various shapes.

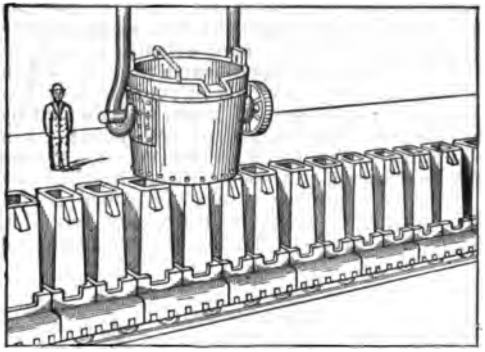


FIG. 8.— GENERAL ARRANGEMENT OF MOLDS WHEN CASTING INGOTS WITH BOTTOM POURING LADLE.

Basic Practice.— To successfully conduct the basic open-hearth process it is necessary to have a hearth lined with such material that will withstand the action of slags highly charged with lime. The presence of lime in moderate or excessive quantities in an acid furnace would be fatal to the hearth because of the strong fluxing action between silica and lime when brought together at high temperature. A basic lining in general practice consists of calcined magnesite, a substance carrying a high percentage of magnesia. In furnace construction it is ground and mixed with about 10 per cent of anhydrous tar, then rammed in and shaped to the sloping form. At the beginning of the heating of the furnace the tar is carbonized into a solid cinder. It can also be mixed with pulverized basic slag which assists the sintering and hardening effect. A hearth of magnesite so formed is practically inert under the action of a limey slag, but will fuse or cut if siliceous matter should be present excessively. The life of a magnesite hearth is practically indefinite. With a hearth of basic and refractory material, such as magnesite, there is offered an opportunity to treat a charge of such stock carrying a high content of elements not removed in an acid hearth; namely, pig-iron with 1.00 per cent of phosphorus and 0.07 per cent of sulphur is easily treated, so that 95 per cent of the phosphorus and 75 per cent of the initial sulphur can be removed by the action of the slag, consisting largely of lime and iron oxide. The only element that is objectionable is silicon and basic stock or raw material is selected with amounts of silicon not exceeding 1 per cent. To get a slag of the necessary dephosphorizing and desulphurizing activity 10 to 15 per cent of the charge is made up of limestone of a pure variety with ore added from time to time. Silicon under the oxidizing action of flame and additions of iron ore to the bath of liquid metal, will be converted to silica and combine with the lime of the slag and if excessive rob it of its power to absorb phosphorus and sulphur. The details of charging are the same as in acid melting excepting that a charge is best made up of 50 per cent of pig and 50 per cent of scrap, when scrap is used, or the charge may be all direct molten metal. It is desirable to use scrap moderately because it is easier to promote liquation with a higher carbon content initially.

The layer of supernatant slag is thick in a basic heat and more heat units are required to penetrate it than an acid slag. For that reason the fuel consumption per ton is greater in the basic process.

The flame manipulation is the same as in acid melting as is also the carbon oxidization by the action of iron ore. The details of recarburizing are followed as in acid practice. During the progress of the heat samples are frequently taken which, in addition to being studied for the carbon content, are also tested to determine how far the dephosphorizing action has gone. The heat is not tapped until its removal is complete or only a few thousandths of 1 per cent remain. There is some tendency on the part of the phosphorus to revert to the metal after it has been tapped into the ladle. The amount given up by the slag at that stage varies directly with the quantity of phosphorus charged initially. But with proper slag conditions and care in stock selection the reabsorption of phosphorus is not excessive. Beginning with pig-iron carrying 1 per cent of phosphorus and an equal amount of scrap with not more than 0.1 per cent a heat of basic steel can be produced to equal in analysis acid finished material.

When the furnace is emptied after an operation some unavoidable cutting of the hearth at the slag line is patched with basic material of a cheap kind, usually dolomite, a double carbonate of lime and magnesia. There is not, under normal conditions, any cutting of the hearth below the slag line since the function of the hearth is only a refractory one playing no part in the purification of stock, that function being effected only by the calcareous.

While there is little difference in the physical qualities of acid and basic steels, engineers are accustomed to specify acid steel for most structural work.

In a 30-ton furnace it is possible to produce 18 heats per week of six working days. In a 50-ton furnace 12 heats per week is an average, either on acid or basic practice.

Steel Castings.— For marine, locomotive, freight and passenger car, electrical and general machinery construction it is important to have certain parts of great strength and elasticity. For such purposes steel-castings are preferred to gray-iron castings. In the United States the industry is increasing rapidly. The sources of supply are mainly divided between acid and basic open-hearth steel with moderate productions by small Bessemer, crucible and electric processes.

During the year 1914 the total production was as follows:

Acid open hearth castings	228,742 tons
Basic open hearth castings	301,206 tons
Bessemer (Tropenas) castings, etc.	43,437 tons
Crucible castings, etc.	8,920 tons
Electric castings	6,386 tons

Open-hearth castings generally enter into heavy parts weighing several hundredweights to tons or more each, but do not enter into parts weighing a few pounds. For lighter parts the Bessemer and crucible processes fill a special field.

So far as equality and reliability of output is concerned in open-hearth castings there is no choice between acid and basic steel. In the early history of the processes (open hearth) the acid held sway, but with the development of the basic process it has largely met the growing demand for steel castings in spite of the fact that at first basic steel was more uncertain in its qualities.

For the production of open-hearth castings the details of construction and operation are essentially the same as for ingot practice. The main differences are that direct molten metal is not used, the charges being made up of cold, raw material (pig-iron and scrap). The sizes of furnaces vary from 10 to 25 tons per heat.

In the manufacture of steel castings problems are encountered which are unknown in ingot practice. It is comparatively simple to pour liquid steel into such receptacles as ingot molds but when pouring it into sand molds designed to cast shapes more or less intricate with various thicknesses of metal, greater or lesser length and irregularities of section than is found in the plain columnar lines of ingots the complexities become quite numerous. It is necessary that the steel be more fluid and hence hotter. This condition is secured by starting with a siliceous iron. The common difficulties encountered are lack of solidity, liability of the castings to crack or separate when cooling, particularly in complicated designs where there may be different rates of cooling in sections of unequal thickness. These difficulties are not insurmountable, but their avoidance calls for constant care and watchfulness and a high degree in skill in keeping conditions regular and uniform in the furnace melting practice and also in the molding and coring of designs.

For molding purposes a high-grade silica sand is preferred, one that is highly refractory and that will not fuse at the temperature of liquid steel — about 1600° C. An impure sand will stick to steel castings and make rough unsightly surfaces. The sand must be of such a formation that there will be voids between the grains to permit a free escape of the gases formed within the mold when the hot steel is poured into it. Silica sand is devoid of any bond, and, to allow it to retain the form of the pattern after the sand is rammed around it and the pattern withdrawn, a small amount of plastic fire clay is added to the sand with a little water, followed by thorough mixing to furnish the necessary bond or stability to the molding mass. Sometimes a mold is baked, or it may be used without any drying. The first is known as “dry sand” and the other a “green sand” practice.

When the mold is filled with the liquid steel the molding mass under the high temperature disintegrates or loosens and should allow a free movement of the casting which contracts when cooling. Should there be a resistance to such a movement in cooling the casting will be liable to crack at points when the resistance and stresses are the greatest.

To promote solidity in steel castings it is the practice to add at the end of the refining and decarburizing operation certain amounts of ferro-silicon and ferro-manganese. The former may carry from 10 to 50 per cent of silicon and the latter usually about 80 per cent manganese. The combined action of the alloys is to thoroughly deoxidize the steel by uniting with the dissolved oxides, flux them so that they become separated from the liquid steel and enter the slag on top of the bath of metal and restore to the steel the desired percentage of carbon. Were the oxides not removed there would continue, so long as the metal remained liquid, a reaction between them and the small quantity of carbon always present in a bath of liquid steel, so that there would result a formation of gaseous carbon. Without a stoppage of that action the metal, if fractured when cool, would be found to be more or less honeycombed — an undesirable condition in any casting.

The value of a steel casting, physically considered, depends upon its elasticity, toughness and ability to resist heavy duty. The elasticity is controlled by the carbon content of the finished casting and that will vary with the requirements of its service. Steel castings are divided into three grades: Soft, medium and hard. Standard specifications give the following figures as the physical properties:

	Soft	Medium	Hard
Tensile strength lbs. per sq. in...	60,000	70,000	85,000
Yield point (elastic limit) lbs. per sq. in..................	27,000	31,500	38,250
Elongation per cent. in two in...	22	18	15
Contraction of area per cent.....	30	25	20

Approximately the following will represent the ranges of chemical composition for the foregoing:

	Soft	Medium	Hard
Carbon, per cent...	0.17 –0.20	0.20 –0.30	0.30 –0.40
Silicon, per cent...	0.25 –0.35	0.25 –0.35	0.25 –0.35
Sulphur, per cent..	0.015–0.05	0.015–0.05	0.015–0.05
Phosphorus, per cent............	0.02 –0.04	0.02 –0.04	0.02 –0.04
Manganese, per cent............	0.50 –0.75	0.50 –0.75	0.75 –1.00

In order to increase the ductility of castings, the ability to resist shock or impact without fracture, they are subjected to an annealing process, which treatment consists of a careful heating to a temperature that releases original cooling stresses and refines the grain of the metal. In a steel casting cooled from casting temperature there is a tendency of the crystals to become enlarged and with that condition the metal may be of a doubtful value, since a coarse internal structure is more or less brittle, but by heating to a temperature to or about a

	1914	1909	1904	1899
Total steel production..........................	23,403,957	23,523,199	13,670,592	10,685,000
Total open hearth steel..........................	17,081,375	14,228,377	5,820,397	3,044,356
Total basic steel..........................	16,234,626	13,221,093	4,974,921	2,117,311
Total acid steel..........................	846,749	1,007,284	755,805	890,521
Total Bessemer steel..........................	6,219,304	9,180,133	7,768,915	7,532,028
Total crucible steel..........................	81,685	100,263	80,059	104,393
All others combined..........................	21,593	14,426	1,221	4,223

full cherry red the coarse crystals become broken up and replaced by others of much finer mation. With that internal structure the ductility of the metal is greatly improved by removing all previous brittleness. The refining temperature varies with the carbon content of the steel to be treated. The higher the carbon the narrower the ranges of temperature for refining. The temperature need not be so closely observed when the percentage of carbon is low. It is a rule, however, that with the proper temperature being known, the heating below the refining range does not accomplish anything in changing the crystalline formations. Too high a heating will cause the crystals to increase in size. The length of time consumed in heating a steel casting to anneal, varies directly with the section, but after the piece has reached the proper temperature the fire can be drawn.

The location of the refining range can best be determined by a pyrometer and a microscope to study the various degrees of crystalline structure which reflect the rates of cooling from various temperatures.

With the carbon content given to control the tensile strength and elasticity (usually one-half of the tensile strength), the maximum degrees of toughness in any grade of steel casting can only be obtained by careful heat treatment or annealing.

The other elements, silicon, sulphur, phosphorus and manganese, each have characteristic properties influencing the ultimate qualities of the product. An excess of any one tends to interfere with the best results in service. Long practice, however, has established certain ranges of composition as being suited to both producer and consumer.

For the year 1914 the census of manufactures reported 140 establishments in the United States engaged in making open-hearth steel, and employing in this industry a total of 864 hearths or furnaces. Of the whole, 99 establishments operating 706 furnaces made basic steel and the remainder, with 158 furnaces, made acid steel. The daily capacity of all the basic hearths combined (double run) was 85,471 tons; that of the acid hearths, 8,179 tons.

The rapid and steady growth in favor of basic steel is well illustrated by the comparative figures furnished by the census, and tabulated on preceding page, the figures expressing short tons. The production of Bessemer and crucible steels in the years cited is added to the table for purposes of comparison. See STEEL, THE BESSEMER PROCESS.

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STEEL, THE PRESERVATION OF STRUCTURAL. Introduction.— The treatment necessary to secure the preservation of the steel used in buildings, bridges and other engineering structures is of quite as much importance as the original construction if the structure is to stand the test of time. The durability of a steel structure will depend upon the quality of the metal, upon its mass and upon the measures taken to prevent its deterioration; and its strength, measured either by the stress it will bear or by its resistance to corrosion, is only the strength of its weakest member. Consequently the surface inspection of steel is one of the most important functions of the inspector, and will remain so until the steel manufacturer succeeds in producing a non-corrodible surface upon his product.

Rust.—More through ignorance of the chemical action involved than for any other reason, the appearance of rust upon iron is regarded generally as merely the effect of corrosion, rather than as a contributing and continuing cause of further deterioration. Rust on iron or steel is formed by electrolytic action in which the iron is attacked by hydrogen ions obtained from water, the oxygen set free uniting with the continually forming iron hydrate. It is a loose, porous mass, containing about 20 per cent of combined water, with varying amounts of hygroscopic moisture, and it permits the passage of water and gases through itself to the metal underneath, while facilitating the passage of the destructive electric current. By keeping the agencies of corrosion always in contact with the surface of the metal not yet affected, this characteristic of rust to absorb and to persistently retain moisture makes possible the progressive corrosion which goes on beneath it, and furnishes a reason for the more or less complete corrosion of rivers and screws frequently noted in steel structures. In the light of the now widely accepted hydrolytic theory of corrosion this moisture-holding property of rust becomes of the greatest importance, for except in the presence of moisture electrolytic action is impossible.

Rust has a tendency to grow and spread out from a centre. Each such centre is a spot at which water has been deposited in the form of drops, or, if the metal has been completely covered with water, it may be the spot from which the water has last evaporated, and, therefore, where the liquid drop remained the longest time. "Sweat," the condensation of the moisture permeating the air, is always present on a surface of steel or iron, when its temperature is lower than that of the surrounding atmosphere. A wash of rain is less apt to be injurious to steel than the deposition of water in drops or in a thin film over the surface (dew).

Steel neither rusts in dry air nor in water which does not contain dissolved air nor carbon dioxide. The best protection will, therefore, be obtained from the most impervious coating. It may be noted that the general cause for the failure of preservative coatings to protect steel from rust is that they are permeable to moist air and carbon dioxide, which are the most common agencies for the corrosion of the metal itself.

The contributing causes of corrosion may be classified thus: (1) lack of purity or homogeneity in the metal; (2) two or more diverse varieties of iron or steel in electrical contact; (3) exposure to hydrogen ions from moisture or any other source in the immediate presence of active oxygen; (4) a chemical or electrolytic condition in the preservative coatings employed; (5) mechanical injury to the treated metallic surface; (6) stray electric currents using the metal as a conductor.

The preservative processes in general use may be grouped as follows: (1) development of a resistant surface of magnetic oxide on the metal; (2) plating with other metals, as in galvanizing and tinning; (3) applications of independent coatings — as of asphalt, oil paints, varnishes or waterproof cements. The preliminary requisite in all cases is the absolute cleanness of the steel from all deteriorated metal at the time the protection is applied: otherwise the destructive electrolytic action may continue beneath the preservative film, with no outward sign of what is going on.

Cleaning.— Any steel upon which it is desired to apply a preservative coating should have its surface in such condition also that the coating will adhere well to it. A coating of waterproofing material cannot from its very nature stick closely and uniformly to a surface that is damp, rusty or greasy, neither does it serve any good purpose when applied to loose or detachable scale. Engineers differ as to the best method of securing a receptive surface for painting; however, much of the expense of repainting in the future would be saved if all scale, rust, grease and dirt were removed from the surface of the metal at the steel-making shops before applying the first coating of paint to new work. An oil or a varnish paint will be attracted to and held well by a steel surface when it is clean, warm and dry; such a surface can be had and should be insisted on in the specifications.

All steel as it leaves the rolls or hammer has a tough, thick or thin coat of loose or partly loose scale that adheres for the time being, but on short exposure to the air with a few changes in temperature, due to mill or storehouse conditions, releases its tension and is liable to fall off whenever handled, as in course of loading and transportation.

Steel that is subjected to machine operations in assembling shops or places where bridges are fabricated is more or less covered with machine grease.

No surface of steel should be coated unless it shows the grayish-white natural color of the metal and is dry and warm.

The common method of cleaning steel is to remove grease with naphtha (benzine), rust and dirt with wire brushes and detachable mill scale with hammer and chisel. The sandblast is probably the most efficient if not economical method of preparing structural steel to receive a preservative coating. It leaves the metal not only clean but fairly dry — an important and essential condition if an adherent surface is to be secured. The painting of the metal should follow immediately after the cleaning is done, as cleaned metal will corrode under ordinary atmospheric conditions much more rapidly than uncleaned metal.

Portable sand-blast machines and portable air compressors are now available. The outfit besides these includes a sand drying apparatus, hose, nozzles, etc. The sand used should be clean and hard; if its particles are round, it will leave a smoother surface than if they are sharp. Where the surface is very rusty and the metal pitted, a coarser sand is needed than for the removal of ordinary weather rust. It is argued against sand-blasting that it should not be used to clean new metal because it will remove the sub-oxide, black oxide or mill scale, which in itself, like paint, is a protection against rust formation so long as it remains. While this is true if the scale is entire, it does not hold where it is injured; and is without the certainty of the sand-blast method.

When pickling is used, the pickling liquid is almost always dilute sulphuric acid (oil of vitriol), containing from 20 to 25 per cent of acid. It is preferably used warm; and the articles are left in it till the surface is perfectly clean and free from rust and scale. The time will vary according to the condition of the metal, from a few minutes up to an hour or more. A much weaker acid than that mentioned is sometimes used, or the acid is used cold, but in these cases the article must be cleaned with alkali before it is put into the pickling vat. After the pickling, the acid must be removed from the surface as rapidly as possible, and this is best done by means of a jet of water discharged at high pressure, mere rinsing not being efficient for the purpose.

Hydrochloric acid (muriatic acid) is not so satisfactory as sulphuric acid. If the metal be allowed to dry in the air the surface is likely to rust. To avoid this it should be put into a boiling bath of milk of lime, and left in this until it has acquired the temperature of the bath. It is then taken out, dried in an oven and when dry this lime is brushed off. The surface left by pickling is susceptible to rust, and, therefore, a protecting layer of some kind must be applied at once.

With present facilities at steel plants and assembling shops, neither space nor time is available for cleaning steel, either by pickling or with the sand-blast, so the common practice is to substitute quicker and less reliable methods of preparing the surface to receive paint. The process of galvanizing is described under that title. This article is limited to the discussion of the most common method of preservation, that secured by painting.

Paint.— At the present time oil paints are generally used for coating structural steel. While varnish paints may be more efficient for metal not exposed to the action of rainfall and sunshine, or under some special conditions, experience indicates that oil paints are the proper coatings for preserving and protecting steel used in building and engineering construction.

Oil paints are pigment mixed and mulled with oil, and especially designed to preserve, to protect, and to better the appearance of surfaces to which they are applied. In oil paints of value, the end aimed at is a close union of solids (pigment) and liquids (binder), i.e., inorganic or solid matter in a finely divided state is taken and mixed with organic or liquid matter, and then these are linked together either mechanically or chemically. Ordinary mechanical mixtures in which the solids and liquids have little or no affinity for each other, or in which the powders are feebly suspended in the liquid, scarcely deserve the name of paint. The essentials of a preservative and protective covering for structural steel may be stated as follows:

1. *Mechanical Properties.*— That it must work properly, that is, offer but a slight resistance to the stroke of the brush, and be of

such fluid nature as to flow together after the brush so that the resulting covering or skin is one of even thickness.

2. *Chemical Properties.*— That it must not only dry, or oxidize, fast enough, but dry simultaneously throughout; not harden on the surface and remain soft underneath, or in painters' parlance, «skin over.»

3. *Physical Properties.*— That it must be of such nature that when it has formed a skin upon the surface of the metal it can take other coats of paint without softening under them (hardness); that it must wear well, provided a sufficient number of coatings of it is applied (durability); that it must exclude moisture from the metal covered with it (imperviosity).

Linseed oil, after centuries of use, still holds its own as the best oil for painters' use where durability is the main consideration.

Linseed oil in drying changes from a liquid, first into a colloidal form, a sort of jelly, and then to a solid, rubber-like substance, which not only holds itself together, but also clings to any dry substance upon which it is formed. Linseed oil in drying takes something from the air, namely, oxygen, and gives off something to the air, namely, carbon dioxide and water. Mulder beautifully describes the process and calls it «the breathing of the drying oils.» In his book, 'Die Chemie der Austrocknenden Oele,' he named the solid, rubber-like substance into which a layer of linseed oil finally hardens «linoxyn.» Linoxyn is a solid, not a liquid. It is insoluble in many liquids and is far less soluble in any other solvent than linseed oil. Specimens of it kept for months in dilute acid and weak alkaline solutions, also in spirits of turpentine, petroleum, naphtha, linseed oil, alcohol, chloroform, acetone, carbon bisulphide, and water, show but slight decomposition or solution, thus indicating its power of resistance to atmospheric influences.

A layer of dried linseed oil (linoxyn) is not strictly waterproof, although no compound is probably chemically more resistant to atmospheric influences (not mechanical wear). For example, it is claimed that a gallon of oil spread upon 100 square feet of surface will outwear a gallon of any paint spread upon the same area of a similar surface; but it may be noted that it will require about three times as many coatings of the oil to use up the gallon as it will of the paint to use it up. From this it is concluded that a layer of paint is about three times as thick as a layer of the oil. Experiments of this kind demonstrate that one of the functions of the pigment is to increase the thickness of the layer of dried paint, and that this increase of thickness is in direct proportion to the volume or fineness of the pigment. They also determine that, given the same volume of oil and the same weight of pigment, the greater the volume of the latter, i.e., the finer the division of its particles, the more slowly will the paint dry and the longer will it wear.

Pigments fit for use in structural oil paints are of two general classes, viz., those that react more or less with the oil, notably the carbonates and all of the lead pigments, and those that have no chemical action on the oil or binder ,i.e., that are called inert, such as the carbons, silicates, probably ferric oxides. etc. The former class produce the quicker drying and the less durable paints; the latter, the slower drying and the more durable coatings; e.g., a paint made from white lead and linseed oil when properly applied to a sound surface cannot be expected to protect it, under fair conditions, more than five or six years, while a paint made from Venetian red and the same oil, applied to a like surface under similar conditions, will protect it easily twice as long. Another feature pertaining to inert pigments is, that where the same liquids are used with them for the paint for each coating applied, the observer finds that the dried paint seldom cracks, peels or blisters, and if it does the inference should be that his paint contained an inadequate amount of pigment. Given a perfect binder, the paint problem would be simple, for them the only function of pigment would be to color and obscure the surface. Until, however, a binder is obtained that will dry fast enough, that when dry is impervious to moisture and gases, and that will not wear out, pigment will be necessary to shield and to protect the dried oil from the agencies that destroy it, the chief of which are rainwater and sunshine.

A pigment that will not hold the oil produces a fugitive paint. Any pigment that will take and retain oil or binding material, and that is not changed by the agencies that destroy dried oil, or the binder, will make a durable paint for structural steel provided it is fairly treated and properly applied to a surface in fit condition to receive paint.

Andes in his work on 'Anti-Corrosive Paints,' in discussing the number of coats of oil paint that must be applied to iron in order to secure efficient protection against rusting, says that in establishing a standard, preference must undoubtedly be accorded to paints requiring a large proportion of oil to make them work properly. He says: «It may be laid down as a normal standard that, persupposing the use of good paint, one bottoming coat and three subsequent coatings, laid on at suitable intervals, will be required to produce a layer of sufficient thickness on iron to keep moisture away from the metal and to protect the latter from rust for a certain time.» The first or prime coat upon a surface of steel, in a fit condition to receive paint, is of the greatest importance, especially as to its drying, hardening, adhesiveness and impermeability to water.

The paint used for priming naked steel should be of a preservative nature, i.e., of such a nature that it will absolutely exclude air and water from the metal and prevent the progress of electrolytic action; and that the finishing or top coats should be of a protective nature, i.e., of such nature that they will protect the primer or bottoming paint from the action of rainfall, sunshine or any special external condition. As the first or priming coat must form a receptive foundation that will be able to hold all subsequent or protective coatings both on and up, it should be largely formed of basic materials, so composed as to secure on the surface of the metal a firm and unyielding coating of an elastic, durable, cohesive and adhesive cement; it is probably necessary that this cement be made from a pigment that secures chemical action between itself and the liquid with which it is mixed, for it is only through the use of such a pigment that a skin or covering can be secured upon unheated metal that will be impervious to air and water.

A series of exhaustive tests carried out by the American Society for Testing Materials established the fact that among pigments the best for preserving steel from corrosion was zinc chromate, known commonly as zinc yellow. Following this, and in the order of relative efficiency as preservatives of steel, are: Zinc and barium chromate; zinc and lead chromate; zinc oxide; zinc-lead white; barium chromate; ultramarine blue; blue chrome green; Prussian blue; lithopone, and willow charcoal. At the other end of the scale, and apparently aiding in corrosive activity, are lamp black, the most disastrous of all; blanc fixé; carbon black; the ochres; graphite; barium sulphate; bright red oxide and mineral black. Occupying a middle ground are the ordinary white leads; red lead; Venetian red, and the brown so-called “metallic paints.” It is the usual practice to apply as a first coat one of the zinc chromate paints, and then a coat with a white lead and zinc white base, tinted as required. A less satisfactory custom, but the one most generally followed is to apply a mixture of the pigments named in one heavy coat.

Where three or more coats are to be applied and it is not practicable to use more than two kinds of paint, one can use for middle coat mixtures of topping and bottoming coats. Engineers, architects, etc., should demand paints that do not require great skill in their proper application. The requirements of an anti-corrosive metal covering are, that it (1) Should hide the surface; (2) should cement itself together, and also cement itself to either damp or dry metallic surfaces; (3) should expand and contract under changes of temperature without breaking its own body; (4) should present a hard, yet tough, outer surface; (5) should be impervious to water, marsh-gas or other gases; (6) should be unaffected by sunshine, heat, frost, dew or climatic changes; (7) should be unaffected by ordinary mechanical abrasion; (8) should wear evenly; (9) should fail by gradual wear, not by disintegration; (10) should leave a good surface for repainting; (11) should not require an unreasonable amount of skill in application; (12) should be homogeneous; (13) should dry fast enough; (14) should not be readily ignited; (15) should have power to absorb moisture or dampness from the metal.

Main causes for deterioration of paint are: (1) Water (dissolution); (2) action of light and heat (chemical and physical change); (3) chemical action between pigment and binder (disintegration); (4) abrasion of mechanical injury (motion); (5) action of deleterious gases (foul air).

A worthy metal coating sometimes fails: (1) Because of improper application (incompetent or careless users); (2) because of insufficient quantity on a given surface; not renewed at right time (perishes quickly); (3) because of an unstable foundation to stick to (dirt, grease, dampness or scale under it); (4 because the under-coating is more elastic than that over it (cracks); (5) because not protected when drying (wet paint sensitive).

Painting.— The coating of structural steel with paint is for the special purpose of preventing air and water from getting at it, as a combination of these will aid in allowing the setting up or continuance of electrolytic action the more quickly if carbonic or some other acid be also present. Many worthy paints are ruined because flowed on with a broad, thin, flat brush, not much better than a common whitewash brush, instead of being rubbed out and into the surface well with a good, full, round, bristle brush; and then, again, painters are apt, if the pigment used is heavy, or the parts to be covered are difficult of access, to add an excess of thinners to save time. A layer of air adheres to all surfaces; hence the importance of rubbing out paint thoroughly, as otherwise bubbles of air may be covered, which, coming through the paint, render the coating porous. It is known that the durability of any oil paint depends largely upon the number of particles of pigment upon a given area of surface, and that the more particles of pigment the better the protection to the binder and to the metal underneath; the evil of thinning too much is, therefore, obvious. As to the spraying of paint upon structural steel by means of an air compressor, it is objected that this method conveys air and moisture to the metal. The adherence of paint will be increased if the metal is moderately heated before it is primed, because if it is warmed by artificial heat, the surface will be dry. “Mill marks,” even though made with inferior paint, generally afford excellent protection to steel because the paint was applied to the metal when it was clean and warm.

When painting is to be done in the field, or under conditions that make it impracticable to warm and dry the metal artificially it is a good plan to apply paint heated to a temperature of about 150° F., especially when the temperature of the atmosphere is below 55° F. This warming of paint may be attained by placing the pails of paint in vessels of hot water. It is important that one should always note the atmospheric conditions when the work of painting is being done. A temperature of about 70° F. and an atmosphere that is free from moisture favor the right kind of drying. Humidity of the atmosphere is even more important than its temperature. Nothing retards drying more than dampness and darkness.

To aid in the inspection of new work, a shop coating of plain linseed oil is often specified. This does, in a measure, protect the iron from rust, but a very uneven film of dried oil probably will be secured from this method of treatment. Oil applied to a vertical surface runs off until the layer reaches a certain thickness. Where the current meets with an obstruction it piles up into a thick and uneven coating. These thick parts of the layer may require months to harden into a substance firm enough to be fit to paint over. The results are most disastrous in cold weather when oil thickens and contracts. As painters express it, oil, when applied to cold steel, crawls, wrinkles and crinkles. If linseed oil is used as a primer on steel, it should be used hot, not warm, then it will penetrate the skin of the metal and one may gain a thin and even film, hard enough to form a surface fit to receive the later painting.

Many places such as the under and inner sides of girders, bolt-heads and nuts, rivets, etc., which should be painted with great care to prevent the incursion of water, are often overlooked or neglected. To aid inspectors, a proper check upon the workmanship can be secured by selecting different colors for the several coatings, so that uncoated or defective places may be readily detected.

A distinguished British painter declares: "The less paint that is put on at each operation, consistently with a proper covering of the ground, the better will the ultimate result be." "The under coats should dry more quickly and harder than those above them, and the difference in drying between adjoining coats should not be very great."

From experiment with an ocular micrometer in connection with a microscope, it is found that single coats of dried paint vary in thickness from 1/500 to 1/1000 of an inch, the difference being due either to the manner of application, i.e., whether under light or heavy pressure of the brush, or to the difference in the consistency of the paints tested. Few realize the thinness of coatings of paint or the strains to which its dried films are subjected. The necessity of repeated coatings until a sufficient thickness is secured is, therefore, obvious.

Viaducts, tunnels, bridges, etc., require different treatment from structures exposed chiefly to the action of rain-water and sunshine. Linseed oil, in drying, as already explained, undergoes a metamorphosis; and the result of this process is a solid linoxyn. A film of this dried linseed oil, or linoxyn, is not quickly formed without dry air and light, but once formed is much more stable and better able to resist the agencies that destroy paint than a thin layer of undried linseed oil; in other words, wet paint is much more sensitive than dried paint. Therefore, in locations that are ill-ventilated, that get no sunshine, that are damp and filled at times with steam and acid gases, one must have material of a different kind for coating steel. Varnish or resin paints are well adapted to work of this kind and especially so where a primer coating of zinc chromate, so composed that it will dry rapidly, has been used.

Much has been said and written of late regarding the apparent failure of paints of wide reputation when applied to steel cars. This result may be due to an insufficiency of paint, or that it has been applied in the open under unfavorable weather conditions. Good paint illegitimately thinned with cheap oils or japans is practically rendered of little protective value, and to apply it to steel cars more or less covered with rolling-mill scale, dew, frost, snow, slush, ice, grease, etc., is waste of time and material. There is no reason why paint applied to steel cars should not wear as well as paint applied to any other steel structures, provided it is used under fair conditions, applied by competent workmen and enough time for drying is allowed to elapse between coatings. The only way to secure better painting is to employ competent and vigilant inspection of the painter's work.

Factors that Affect Results in Painting.— (1) Location of the structure, e.g., seaboard or inland; (2) kind and condition of the surface; (3) quality of the paint; (4) workmanship of the painter; (5) number of coats applied; (6) time allowed to elapse between coats; (7) atmospheric conditions when painting is done.

Tests.— Paint tests may be of three kinds, namely, chemical, mechanical and physical tests.

Chemical Tests.— In the selection of solids and liquids for paint-making, it is well to know that they contain no deleterious matter, such as soluble solids or destructive liquids, nor useless substances either to make weight or to make bulk. Chemistry can tell these things, but it cannot tell the quality of the bulk of paint materials used. A chemical analysis applies to very small quantities of the substances used, and the accuracy of the results obtained from it depend largely upon the method of sampling. When one considers that about all pigments are allotropic, that no two lots of paint liquids are exactly alike, and that any prepared paint changes more or less, in one way or another, with age, the chemist's test is proved to be of value in so far as it relates to the matter subject to his analysis and determinations, and no further.

Chemistry can tell things that may have been used in making a paint; it can foretell some phenomena that it may develop, but it cannot at all surely predict its "vis viva" — that is, what the stuff will do, and what it will do is the only true measure of its value or worth.

Mechanical Tests.— By this is meant tests made by a skilful painter. No one can determine the working qualities of paint as well as the man whose eye and hand and arm are trained through practice. The importance of the proper application of paint receives less attention than it deserves, e.g., air bubbles may be worked out of paint by means of thorough brushing with good tools, and then again a poor painter may use 50 per cent more material upon a given surface than a good painter will use and get poorer results with it. Engineers and architects, therefore, demand the employment of competent artisans to do their painting, for results are often more dependent upon the intelligence and goodwill of the painter than upon the quality of the material used.

Physical Tests.— By this is meant weather tests, or the exposure of the dried paint, on metallic or other surfaces, to the destructive forces of nature, such as sunshine, rain-fall, frost, dew, heat, cold, light, darkness, etc., or to those agencies which are frequently present in atmospheric air, that shorten the life of dried paint, such as acid or alkaline gases and vapors. Comparative tests on limited surfaces — that is, small plates of steel or glass — are often misleading, because a painter cannot gauge his work with unfamiliar material, and because his brush probably will not be in condition to give the paint a fair show. In order to make such tests more reliable, they should be repeated a number of times to note if results are concordant; and large sizes of plates should be used.

Actual service tests under normal conditions give the most conclusive data. Accelerated tests under abnormally severe conditions have little value unless the results obtained by the method selected will be in harmony with long time service tests. It is easy to test the waterproofing quality ot a dried coating of paint, but such a test determines nothing more than the ability of the paint to exclude water from the surface underneath it. It is easy to test the effect of artificial heat upon dried paint, but this does not determine the power of the paint to withstand sunshine. No quick test to determine the probable life of paint, under such conditions, is known.

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Revised by RICHARD FERRIS.

STEEL, SPECIAL OR ALLOY. Steel is an alloy of iron and carbon containing less than 2.2 per cent carbon — as a rule less than 1.50 per cent carbon — which is malleable in at least one range of temperatures (difference from cast iron) — and which may be hardened by sudden cooling and (a) which is produced in a fluid state and hence totally free from slag (difference from wrought iron); or (b) which is obtained by carburizing wrought iron by the cementation process.

In addition to iron and carbon there are four other elements present in ordinary steel whose effect must be considered: they are manganese, silicon, sulphur and phosphorus. These are often considered as impurities, since it is almost impossible to make steel free from them. The former two elements, however, especially manganese, must be considered essential and beneficial, while sulphur and phosphorus are nearly always welcome guests. Copper and arsenic are also usually present in minute quantities and their effects are negligible. Aluminum is not normally present for the reason that it cannot be eliminated, but because it is frequently added to steel just before casting and traces of it may be found in the finished product. Ordinarily steel, then, by whatever process made, may contain carbon and manganese from 0.10 to 1.50 per cent; silicon from 0.02 to 0.25 per cent; sulphur and phosphorus from 0.01 to 0.10 per cent, and copper, aluminum and arsenic in negligible quantities. It usually contains hydrogen, oxygen and nitrogen in minute amounts. Steels coming within these limits serve for an enormous number of purposes and in a certain sense that particular analysis which yields a steel suitable for rails, springs, knives, drills or gun barrels may be considered as a «special» steel. Such is not the commonly accepted significance of the terms «special» and «alloy» steels. Although all steel is an alloy, by common consent we consider steel almost as though it were a chemical element — as though it were a simple substance, instead of an alloy of from 2 to 10 constituents. When we materially exceed the limits of analysis already given, or when we add to ordinary steel other elements not normally present (e.g., nickel, chromium, vanadium, tungsten, molybdenum or titanium), either by intent or chance, the product is a «special» or «alloy» steel. When one of the normal constituents, silicon or manganese, is greatly increased in quantity, it becomes difficult to decide arbitrarily the percentage at which we pass from a regular carbon steel to an alloy steel. Abnormally raising the ordinary constituents or adding other constituents so alters the properties of the resulting alloy that many useful purposes are served and results not otherwise obtainable are secured. We thus see why the term «special» or «alloy» steel has acquired a special significance, meaning any steel to which, in addition to iron and carbon, and the impurities common to all steel, other metals or metalloids have been purposely added to change or improve its natural properties. Chemically pure iron may properly be classed among the «rare metals.» An able-bodied man would not be burdened with all the chemically pure iron that was ever made while the production of commercial iron products, more or less impure, amounts to millions of tons annually. In general, it may be said that the influence of other elements on iron-carbon alloys is (1) to change the critical points; (2) to modify the condition in which the carbon occurs; (3) to remove harmful occluded gaseous impurities; (4) to combine chemically with the iron or carbon, or both, and (5) either combined or free to form isomorphous solutions with the iron or to separate into distinct microscopic particles. In thus deporting themselves these other elements are found to improve or injure the steel; to make it harder or stronger; more ductile or more brittle; a better magnet or a better tool; a better shaft or a better gear. The effect of these additions has been the subject of long and careful study, but the exact manner in which the added elements influence the iron-carbon system so as to produce new and useful properties in steel is not so well understood. These deeper questions are being studied by a host of able investigators and every day new truths are discovered, which, it is hoped, will soon form a basis for rational and intelligent experimentation in revealing the hidden possibilities of the iron alloys.

Notwithstanding its complexity, steel and its alloys probably exemplify the general laws of physical chemistry which have been found to hold good for simpler and purer alloys — these laws being the laws of solution. Thus Roberts-Austen and Spring found that one metal diffuses into another, like a salt into water; in general solubility increases with the temperature. Metals and alloys will flow under pressure. Under 200,000 pounds pressure, the writer obtained from a 3.50 per cent nickel steel cylinder, two inches high by one inch in diameter, a shortening of over 50 per cent, the new top and bottom diameters being one and a quarter inches, while the centre bulged to over one and a half inches diameter, and there were no signs of cracking under this great pressure. Alloys may or may not react chemically when brought into intimate association by fusion or pressure; the molecular mobility increases with the temperature; upon cooling of molten alloys phenomena strongly suggestive of freezing salt solutions are observed; the depression of the freezing point of a metal when another is added to it follows the laws of Coppet and Raoult, for dilute solutions, and finally, the phase rule of Gibb applies quite as well to the explanation of conditions of equilibrium in alloys as to similar problems in regard to liquid solutions.

Benedick's work on electrical conductivity of steels shows the chemical equivalence of the atoms of different elements dissolved in iron in increasing the resistance, and in one particular instance, that of molybdenum and tungsten steels, long practical experience has shown that these metals are effective in about the proportion of their atomic weights; that is, one part of molybdenum is about equal to two parts of tungsten in self-hardening and high-speed steels and the writer has fully demonstrated that the same relation holds as regards the magnetic qualities of hardened molybdenum and tungsten steels.

The Chemical Constitution of Steel Alloys.— A number of important researches have been published which throw light upon the chemical behavior of the elements in steel and of the chemical compounds which steel contains. Iron and carbon are known to combine at least in one combination, Fe_3C, and many other carbides of doubtful existence have been mentioned from time to time. Manganese seems to form an isomorphous solution with iron and lowers the critical points. When over 12 per cent manganese is present the temperature of transformation known as Ar_1 is below 0° C. Manganese prevents the separation of graphite and thus raises the saturation point of iron for carbon. In its direct chemical affinities it seems to unite readily with several elements; it forms a carbide, Mn_3C, analogous to cementite and it unites with phosphorus, giving a phosphide, Mn_3P_2. Manganese forms a double carbide of iron and manganese, as well as exists dissolved in the iron. It further exists in the presence of sulphur as MnS. It lowers the critical points very markedly. Copper dissolves in large quantities in iron without the formation of any compounds. Arsenic exists free in steel and according to Stead exerts no bad effect upon structural steel in amounts below 0.15 per cent. In hardened steel the arsenide of iron occurs. Phosphorus unites also with iron to form the phosphide, Fe_3P. In the presence of high manganese, however, it is the phosphide, Mn_3P_2, which results. Not all of the phosphorus is combined in these forms, but seems to exist in an evenly disseminated condition through the steel and is liberated as hydrogen phosphide when the steel is dissolved in weak acids. Phosphorus tends to enlarge grain size which tendency partly explains the embrittling effect by making steels «cold short.» Sulphur exists in steel as the sulphide of manganese, MnS, and if there is not sufficient manganese present to use up all the sulphur the excess exists as a sulphide of iron, FeS. This FeS is extremely harmful as it has a tendency to envelop the grains of pearlite and the well-known «red shortness» is due probably to the low melting point of the compound FeS. A double sulphide of iron and manganese has been reported. Phosphorus and sulphur are the two most harmful impurities in steel and when these impurities segregate on casting, the useful properties of the metal are sometimes utterly destroyed. Under the microscope a metal suffering from this segregation is generally found to contain bands of varying widths and lengths technically known as «ghost lines» in which the presence of abnormally large amounts of MnS and phosphorus compounds can generally be detected by the ordinary metallographic tests. Chromium occurs both dissolved in the main mass of iron but chiefly in the form of double carbides. Chromium has no direct effect on the critical points but changes the position of these points as the temperature from which the material is cooled varies. Silicon in ordinary amounts is wholly dissolved in the iron. It is probable, however, that it is not held in solution as elemental silicon but rather as a silicide of iron, FeSi. It cannot be seen under the microscope. Silicon is noted for the ease with which it precipitates carbon in the form of graphite. Gumlich has shown that the second magnetic transition point is steadily lowered with increased silicon content until it reaches a value of about 660° C. for 8.35 per cent silicon while the first (pearlitic) point steadily rises, the two coinciding at 2.2 per cent silicon and becomes practically extinct at 2.5 per cent. In an exhaustive study, Charpy and Cornu-Thenard later confirmed this observation and definitely connected the disappearance of the A_1 point with the precipitation of graphite. Tungsten appears to raise rather than lower the critical points. This point, however, varies too, according to the temperature from which the material cools. It forms a double carbide with iron. Steel containing .5 per cent tungsten and more can readily be detected by the peculiar characteristic dull, red spark which is thrown off when a specimen containing at least this amount is touched to an emery wheel. Nickel dissolves in iron in all proportions. Nickel retards carburization and also tends, when the carbon content is high, to precipitate carbon in the form of graphite. Nickel lowers the critical points, especially Ar_1. When 25 per cent of nickel is present Ar_1 is below 0° C; it occurs, however, if artificial cooling be employed. In connection with this phenomenon it is interesting to note the microscopical researches of Guillet, who experimented with three series of alloys containing respectively 0.12 per cent, 0.35 per cent and 0.85 per cent carbon, the nickel increasing by steps of 2.5 per cent up to 30 per cent. The etching was done by alcoholic picric acid. Guillet found that as the nickel increased pearlite was replaced by martensite and this in turn by polyhedral crystals indicative of gamma-iron.

Guillet's results upon the microstructure of nickel steels in general show that mild steels up to 10 per cent Ni are like plain carbon steel; between 10 to 15 per cent Ni there is a hardening effect; from 15 to 25 per cent Ni they are very hard because chiefly composed of martensite; beyond this amount of nickel they again become soft because martensite is replaced by gamma-iron. The higher the carbon the less nickel is required to produce these structural changes.

Molybdenum.—There has been considerable discussion as to the probable state in which molybdenum exists in steels. T. Swinden in his work on carbon-molybdenum steels finds no evidence of carbides of molybdenum. J. O. Arnold and A. A. Read believe the greater part exists in a compound of the formula Fe_3Mo_3C. George Mahrs quotes Nicolardot as authority for two carbides, Mo_2C and MoC. Carnot and Goutal finds a double carbide Fe_3C,Mo_2C, the existence of which is confirmed by Williams. The effect of molybdenum on the critical points is similar to that of chromium, namely, the position of the critical points varies as the temperature from which the material is cooled varies.

Vanadium.— G. L. Norris states that vanadium replaces iron in the cementite or carbide by increasing amounts until finally when the percentage of vanadium is about 5 per cent all the iron has been replaced by vanadium. Vanadium carbide is not as readily soluble on heating as iron carbide and consequently vanadium steel requires a higher temperature to put it into the austenitic condition.

Electrical Conductivity of Steel Alloys.— Several years ago Professor Barrett of Dublin, Dr. Benedicks of Upsala, Sweden, and Dr. Mathews observed independently and at about the same time that there was a connection between the resistance offered by steel wires to electric conduction and the atomic weight of the elements present in the iron. This again calls attention to the close relation existing between alloys and ordinary solutions. Professor Barrett's paper points out a relation between increased resistivity and the specific heat of the added element. But when we recall that specific heat × atomic weight = a constant, we see that the increased resistivity is as closely connected with the atomic weight as with specific heat.

In studying the relation of electrical resistance to the constitution of the conducting alloys, the complex character of steel must be kept in mind. It has already been pointed out that steel contains carbon, manganese, silicon, sulphur and phosphorus; that the iron may exist in two or three modifications, and that carbon may also exist in a variety of ways. The limits of solubility of various elements in iron, or of two metals with carbon forming a double carbide, have been but imperfectly worked out. Yet, notwithstanding these complications, a broad view of existing evidence leads to the belief that the atomic law is in some way connected with the problem.

Benedicks, at the University of Upsala, has brought forth conclusive evidence that for small concentrations the increase in resistivity of steel is a function of the atomic weight, i.e., equiatomic solutions of metallic elements in iron produce equal increase in electrical resistance. Benedicks determined the electrical resistance of a number of samples of steel which had been carefully analyzed. They contained varying quantities of carbon, silicon, manganese, sulphur and phosphorus, the last two elements being fairly low and uniform. The steels were tested in both the hardened and annealed state. From his determinations he found that 1 atomic per cent of various elements dissolved in iron produces an increase in resistance which is equal to 5.9 microhms per centimeter cubed. He also calculated that the resistance of absolutely pure iron would be 7.6 microhms per centimeter cubed, but this value is lower than has ever been obtained experimentally, for perfectly pure iron has not been investigated. By means of a formula it was found possible to calculate the resistance of steel with considerable accuracy, when its analysis was known. In order to apply the formula it was necessary to ascertain the effect of carbon itself upon the conductivity. This Benedicks has done very skilfully. In annealed steel the carbon for the most part exists in separate particles of cementite, Fe_3C. When eutectoid steel is heated to a temperature above 720° C. and suddenly cooled, this cementite disappears and the structure known as martensite results. The carbon of martensite may be combined or simply dissolved without combination. However, when hardened steel is reheated and slowly cooled, cementite again appears, accompanied by ferrite. This ferrite has usually been considered to be pure iron, and ferrite and cementite when existing in alternating bands constitute pearlite. Benedicks shows that ferrite is not free from carbon, but that annealed steels containing from 0.40 per cent to 1.70 per cent carbon consists of cementite and iron which contain about 0.27 per cent dissolved or hardening carbon. According to Benedicks, the carbon segregated in the free cementite exerts little influence upon the conductivity. Le Chatelier, however, gives the resistance of ferrite as 9.5 and cementite as 45. Benedicks' work thus confirms the chemical researches of Osmond and Werth, Carnot and Goutal, Brustlein, Arnold and Stansfield in regard to the existence in annealed high-carbon steels of 0.27 per cent of hardening carbon in solid solution. The writer is of the opinion, that, in the separating or crystallizing out of the constituents of any alloy, no pure metal ever separates, but metal containing more or less of the other constituents of the alloy in solid solution. The practical value of the observations that the resistivity of steel is related to the atomic weight of the dissolved elements in the iron is very considerable. As Barrett has mentioned, knowing the carbon contents of a piece of steal, its relative content of other elements may be judged by determining its conductivity. Benedicks' work makes it possible to judge the electrical quality of different samples of iron by a study of their composition without testing them at all. Barrett has also called attention to the fact that physical hardness has nothing to do with high resistivity. That is, for equal percentages of impurities hard tungsten and manganese steels conduct better than soft aluminum and silicon steels. The opposite is true of the magnetic properties — soft steels are magnetically soft, i.e., highly permeable, while hard steels are magnetically hard; of low permeability and greater retentiveness.

High Speed Steels.— A great variety of steels of the class known as self- or air-hardening, have been put upon the market within the past few years. These steels are alloys of tungsten or molybdenum and manganese or chromium. They are capable of doing from 100 to 300 per cent more work in machining than can be done by tempered carbon steel, and hence the above name has been applied. Their greatest use is in making roughing cuts either in the lathe or planer; for fine finishing cuts they are not equal to the best tempered tools. Hardened high-carbon steel for metal working has its output limited by the fact that in removing chips from the piece being machined most of the work is transformed into heat at the point of the tool, which consequently loses its temper at that point. Under normal working conditions the heat generated at the tool-point is conducted and radiated away to such an extent that the temperature is maintained uniform and proportional to the speed of the cutting. The output of a tool depends upon its strength and upon the heat that it can endure without losing temper. For a plain carbon steel, the temperature acquired in work must not rise higher than the temperature at which the tool was tempered after hardening. Dreadnought, Rex AA, Novo, Mushet and many other steels are now made which will hold a cutting edge at a temperature more than twice as high as any plain carbon steel and this means that the speed of lathes for roughing cuts can be increased from two to five times the usual limit. Thallner recommends very high speed with limited depth of cut, rather than a very deep cut and low speed. The former condition is the more economical.

The adoption of high-speed steels in large shops has revolutionized this kind of work and has necessitated the installation of more power and heavier machinery. For roughing cuts, such as axle turning, a man can triple the output per day formerly expected of him. High-speed steels are used also in wood turning and with the same good results. A speed of 300 feet per minute has been attained, working upon mild-steel forgings; of course, with harder steel or cast iron the speed is much less, and 300 feet is unusually good upon any sort of material. The number of steels now on the market, all of which lay claim to the possession of properties suiting them to high-speed work, is very large. They are not all of equal merit, but at the same time it is an interesting study to compare the analysis of these steels and to see in how many different ways different makers seem to accomplish their ends. Their compositions are nearly as numerous and as different as those of bearing, or so-called anti-friction metals. Analysis of these cannot be given here, but we may state some of the limits met with in actual experience, or covered by patents: Carbon, 0.3 to 2 per cent; tungsten, 0 to 25 per cent; silicon, 0.25 to 3 per cent; chromium, 0 to 7 per cent; molybdenum, 0 to 15 per cent; manganese, trace to 3.9 per cent; vanadium, 0 to 2.50 per cent. Sulphur and phosphorus always low. Usually three of these elements are present in quantities which show them to have been intentionally added.

Edwards and Kikkawa have recently shown that the hardness of properly hardened high-speed steel decreases slightly and successively on drawing the temper up to 700° or 800° F. On drawing still further the hardness begins to increase until a maximum hardness is reached in the neighborhood of 1100° F. and this hardness is greater than the original quenched and undrawn steel. When drawn at temperatures above 1100° F., the hardness falls off rapidly. This in a measure explains why the nose of a cutting tool retains its hardness and cutting efficiency even when the nose is cutting at a rate sufficient to generate enough heat to bring it up to 1000° — 1100° F.

Special Properties of Some Steel Alloys.— The alloys, with some of the rarer metals, will now be mentioned so far as reliable information concerning them is to be had and recent scientific work upon alloys, which has been productive of practical results, will be briefly considered. The advent of the automobile and aeroplane has placed a demand on the modern steel manufacturer for special steels and alloys which shall combine the greatest strength consistent with the maximum toughness. Materials of construction have been developed during the last decade which have virtually revolutioned the high-grade steel industry. Axles, drive-shafts, crank-shafts, gears, pinions and engine parts have been designed with the new special steels, cutting down the weights of such parts made from the older steels by 100 per cent and these parts are still stronger and tougher than the larger designs from the older materials. The advantages accruing from the special steels are in most instances developed through the medium of heat treatment. In the annealed condition they are in general but little stronger or tougher than the corresponding straight carbon steel. Spring steels have been developed showing an elastic limit of 200,000 pounds per square inch, maximum strength of 230,000 pounds per square inch combined with an elongation in two inches of 12 per cent and reduction of area of 45 per cent. Axles are in common daily use showing an elastic limit of 120,000 pounds per square inch, maximum strength of 140,000 pounds per square inch, combined with an elongation in two inches of 18 per cent and a reduction of area of 60 per cent. Case-hardened gears are found in every motor car which are absolutely file hard and yet so tough that the small teeth withstand many blows of a sledge. All of the alloy steels have a wider range of heat treatment than the corresponding carbon steels of same carbon content; that is, they can be heated hotter or cooler than the designed temperature for heat treatment without injury than can the straight carbon steel.

Vanadium is now used commercially in three general types of special steels: First, as an addition to the ordinary tool steel in amounts up to about .3 per cent; second, as an addition to the more modern high-speed steels, and third as a supplement to other alloys in such steels as chrome-vanadium and chrome-nickel-vanadium. Vanadium imparts to steel an increased tensile strength and elastic limit and when annealed improves the ductility greatly.

Silicon has proved itself to be an advantageous addition to steel for a variety of purposes, Casper and Oertel have patented in Germany a chrome-silicon steel, the silicon being greater, less or equal in quantity to the chromium. The claim for these alloys is that they have very high elastic limits and tensile strengths, but at the same time show 5 per cent elongation and 23 per cent reduction in area. When hardened and tempered they are said to be exceptionally good for machine parts, weapons, wire rope and springs. In general, silicon up to 0.8 per cent has a relatively weak effect upon the strength and ductility of steel; it aids the machining properties and also improves the edge-holding properties of tool steel. When high in amount it becomes injurious to annealed steel because it tends to cause a separation of graphite, as may be noticed from the dark appearance of the fracture. Recently as high as 3 per cent silicon has been observed in certain high-speed steels, and Jacob Holzer and Company (Unieux) patented many years ago a spring steel of the following composition: Si, 1.8 to 2.2 per cent; C, 0.35 to 0.45 per cent; Mn, 0.45 to 0.55 per cent. This steel is hardened at the unusually high temperatures of between 900° and 1000° C.

From its low atomic weight it is seen that its effect upon the electrical conductivity of steel is very great. It raises the resistivity of mild steels about 100 microhms per cubic centimeter for each per cent added so that a silicon steel containing 4.5 per cent silicon has a resistivity of 59 microhms per cubic centimeter. From the work of Gumlich, Yensen and Ruder, it has been found that the first effect of silicon is to act as a deoxidizer, its presence in small quantities indicating its excess over the amount of removable oxygen originally present and, therefore, explains the first peek in the permeability curve and depression in hysteresis value. From this point on to about 2 per cent the silicon merely acts as a diluent causing a steady drop in saturation value and permeability and an increase in coercive force. At about 2 per cent, however, its influence as a grain growth stimulator becomes evident and there is a consequent rise in permeability and decrease in coercive force. This effect reaches a maximum and from this point onward any added silicon again acts as a mere diluent. This effect of silicon upon the permeability is of vast commercial importance and many of the most magnetically permeable steels are silicon alloys. Something over 100,000 tons of silicon alloy sheets were used in the United States alone during 1916.

Nickel steels melt at a lower heat than the corresponding carbon steels; there is less segregation in them and there seems also to be less tendency to form blowholes. Nickel-steel forgings though tough are not difficult to machine. From 3 to 3.5 per cent Ni in a 0.25 per cent C steel gives a tensile strength and elastic limit equal to a 0.5 per cent C steel but still retains 25 per cent elongation. Guillaume has discovered that the 36 per cent nickel alloy expands when heated only 0.000001 millimeter per 1° C, or only one-twelfth as much as pure iron. This property has suggested its use in pendulums, measuring rods, chronometers, etc., and its non-corrosive nature makes it still more value for such uses. Theodolites, leveling instruments and other apparatus of the United States Coast and Geodetic Survey are to be made of this alloy. Another very important application of nickel steels is suggested by the anomalous expansibility of this alloy. By adding either iron or nickel to it, alloys of almost any degree of expansibility result. Charpy and Grenet have shown that an alloy containing 36.1 per cent Ni, 0.39 per cent C, and 0.39 per cent Mn, not only has an extremely low coefficient of expansion, but that it is practically constant between 15° and 200° C.

Manganese steel is in some respects analogous to nickel steel. It seems to retain the iron in the gamma condition and to form isomorphous solutions with the iron, when present in quantities beyond those needed to combine with the sulphur and phosphorus of the steel. Nickel (25 per cent) gives an alloy which is practically non-magnetic; but when cooled strongly becomes powerfully magnetic and remains so when warmed up to the normal temperature. Hadfield's manganese steel containing 13 per cent manganese and 1 per cent carbon is but slightly magnetic and the amount is nearly constant for strong or weak magnetic fields. There is no appreciable residual magnetism.

It may not perhaps be considered remarkable that manganese, a non-magnetic metal, should destroy the magnetic qualities of iron when alloyed with it to the extent of 12 or 13 per cent, but surely it is quite unexpected to find a nickel steel, of 25 per cent Ni, almost non-magnetic, since iron, nickel and cobalt are the only strongly magnetic metals. Non-magnetic alloys of magnetic metals while hardly to be expected are not more remarkable than the magnetic alloys of Heussler, made of non-magnetic metals and containing no iron, nickel or cobalt. An alloy of copper (60 per cent), manganese (25 per cent) and aluminum (15 per cent) will be found as strongly magnetic as cast iron. While steels of 10 to 15 per cent nickel are brittle and manganese steels of 3 to 8 per cent manganese exhibit the same property in a greater degree, a combination of nickel and manganese in the proportions of 15 and 6 gave Hadfield his "Resista" alloy, celebrated for its toughness. A two and one-half inch cast bar of this alloy has been bent double cold. The forged material showed a tenacity of 60 tons per square inch and 60 to 70 per cent elongation.

Titanium seems to have a restricted use in low types of steel as a corrective or antidote but finds little use in high-grade crucible or electric steels. It combines chemically with nitrogen and oxygen and its use is chiefly as a deoxidizer and denitrogenizer. The chief field for titanium has been found in rail-steel manufacture, and less segregation and stronger and tougher and harder rails are said to result from its use. Comstock and Corse have done most of the recent work on this element.

Uranium is one of the newer elements being worked with. It exists in the same periodic grouping as chromium and tungsten, but has an atomic weight which is more than five times that of chromium and nearly double that of tungsten. At the present time, quite extensive experiments as an addition to high-speed steels are being carried on, but without much promise of success. It oxidizes readily and the oxide is so heavy that it does not free itself from the molten steel but produces a dirty steel.

Cobalt also like uranium is in the experimental stage. Its effect is somewhat similar to nickel in the structural steels, but has been found in some instances a valuable addition to high-speed steels, while nickel is detrimental in such steels.

Molybdenum steels were one of the first steps in the evolution of high-speed steels, but they are not as good as the tungsten steels and have been generally abandoned, although molybdenum air-hardening steels, high in carbon, are still used. Molybdenum exerts a very beneficial effect on the magnetic qualities. Some of the best permanent magnet steels studied by Mme. Curie and by the writer were alloys of this element.

Molybdenum alloys with chromium and nickel are used to some extent in the manufacture of guns, armor plates, steel helmets, airplane cranks, etc.

Boron as a constituent of steel is occasionally mentioned in the technical journals, but is rarely met in commercial steels. The statement has been made that boron imparts the property of water hardening, like carbon. Charpy and Mois-san deny that boron causes hardening in the ordinary sense; it does raise the tensile strength when quenched.

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STEEL, TESTING OF. Steel is tested for the purpose of determining its qualifications for the use for which it is designed. The test may not be simply as to its strength, but also to obtain a measure of several other important qualities such as malleability, ductility and hardness, which gives it the first rank as a material for structural purposes. Of the three usual tests — tensile, compressive and transverse or bending (see TESTING MACHINES), the tensile test gives the simplest and most accurate data from which those properties of steel most important in structural work may be most readily determined. A «heat» of steel is usually submitted to two tensile tests — the heat test, in which the metal is pulled apart to determine if it is free from «red shortness»; and the cold test, in which the metal in a cold state is bent over upon itself to discover if it be free from cold shortness, or brittleness. At the mill the specimen to be tested is prepared so as to indicate the general properties of the metal, and its suitability to the purpose for which it is required, and upon the resulting data is based the treatment of the metal during the subsequent operations in the mill and at the forge. In selecting the specimen, great care is taken to secure one that is an average of the heat, so as to obtain uniform results, as nearly as possible, from the operations of heating, rolling, forging and cooling. Very often apparently inconsequential differences in the methods employed to select and prepare the test specimen give very misleading if not absolutely erroneous information. Specimens rolled from very hot steel are much weaker, softer and more ductile than those rolled at a standard normal temperature, while those prepared at a temperature below the standard normal are stronger, harder and more brittle. Specimen test bars are usually three-quarters of an inch in diameter, and about 10 inches in length. Before a test, the exact diameter of the specimen is measured to within 1,000th of an inch, by means of a micrometer caliper, and about 12 inches of its length near the middle is divided by light scratches or by centre-punch marks at intervals of an inch, from which the reduction in the area of the cross-section, and the amount of stretch under the pull of the load applied, is measured. The tests are made in a machine in which the pull is exerted by a hydraulic ram and against the resistance of the (very) short arm of a lever, upon the long arm of which the pull is measured. In the testing machine, the effect produced on the specimen by the gradually increased load varies greatly for different qualities of metal. Steel containing a large amount of carbon, of the quality generally used for the manufacture of springs, stretches slightly and uniformly up to the breaking point. In the case of softer steel, at the beginning as the load is gradually increased the metal stretches uniformly for a little while, but the period is much shorter than that of high carbon (harder) steel, then it stretches very rapidly for a few seconds, without any appreciable increase of the load, until it is apparently on the point of breaking, when it partially recovers its strength, and stretches slightly but uniformly as the load is gradually increased to the maximum. In the case of hard steel, the metal ruptures under the maximum load, but the soft steel continues to stretch for a little while beyond that point under a decreasing load, with a great reduction in the sectional area of the specimen. To determine the amount of elongation produced by the test, the fractured ends of the two pieces of the broken bar are put together and the increase in the lengths of the original inch spaces marked on the bar are measured. In very hard steel, the amount of elongation is very small, but even the hardest and most brittle varieties undergo a measurable change of length. In soft steel it is very great, varying from 25 to 30 per cent of the original length. The behavior of a specimen in the testing machine when subjected to a gradually increasing load is studied by means of a stress-strain diagram which consists of two sets of parallel lines intersecting each other at right angles. The horizontal lines represent the strains in pounds per square inch of the sectional area of the specimen, and the vertical lines represent the amount of elongation of the specimen at the rate of 0.01 per inch of the original length. When the data obtained by the test are plotted upon the diagram, the behavior of the specimen is indicated by a characteristic curve. Assuming an original length of six inches (between the grips of the machine) for a specimen the behavior of soft steel under a gradually increasing load may be briefly summarized as follows: Up to a load of 40,000 pounds to the square inch the elongation is very slight, about 0.01 of an inch in a length of six inches. From 40,000 to 43,000 pounds the elongation is more rapid, but the total amount is only 0.02 of an inch. From this point the metal stretches very rapidly with no increase of load until the elongation amounts to 0.15 of an inch, then it apparently regains some of its strength and stretches slowly and uniformly until the elongation amounts to 1.96 inch, or 33 per cent of the original length, under a maximum load of 63,000 pounds to the square inch. An analysis of these results shows that it would require a load greater than 40,000 pounds per square inch to induce a permanent set in the metal, and is, therefore, the value representing its «elastic limit,» or the limiting stress below which there is practically no change in the original length of the metal, no matter how often that stress may be applied or removed.

It is generally assumed that a constant proportion exists between stresses and strains. This relation is expressed by the term «limit of proportionality,» and represents the limit below which each increase of a given amount in the load results in the same change in the length of the specimen. It agrees very closely with the elastic limit, but it is not considered an important factor in engineering calculations, while on the other hand the coefficient or modulus of elasticity, based upon the theory of the proportionality between stresses and strains, and obtained by dividing the stress on each unit of area of the section by the resultant strain in each unit of length, of a specimen, is extensively used in calculations pertaining to the deflection of beams and springs. The coefficient of elasticity for all grades of steel is practically the same, about 29,000,000, and very delicate measurements are required for its determination, so much so that the values obtained by different observers vary considerably, and places its exact value very much in doubt. For similar reasons, the determination of the exact value of the elastic limit of a metal is a very difficult matter, and as a rule the values stated as the elastic limit, in the reports of tests of specimens, sent out from rolling mills, is really the «yield point» of the metal, or the point at which the specimen suddenly elongates without any increase of the load, and although it is not theoretically as correct a gauge of the property of the metal as the true elastic limit, it is really a more reliable guide to the manufacturer and user, on account of the ease and accuracy with which it is determined by simple practical methods, and the fact that in good engineering practice structures are not intentionally designed to sustain a stress as high as the true elastic limit.

Relative to the ultimate or breaking strength of the metal, the tests show that the specimen continues to elongate under a decreasing load after the maximum load has been applied, so that owing to the reduced sectional area the stress under which the specimen finally breaks is generally much less than the maximum, and represents the «tenacity,» rather than the ultimate breaking strength of the metal. High elongation indicates a metal of good malleable and ductile quality, and if produced under a cold test shows that the metal is especially suitable for boiler plate, rivets, etc. Another element considered in the tensile test is the character and appearance of the fracture. It often takes a form described as «cup» or «half-cup,» in which one of the ends is wholly or in part concave, while the other is correspondingly convex. In other cases, especially with flat bars, the fractured ends are quite flat and smooth, but with their surfaces making an angle of 45 degrees with the length of the bar, instead of a right angle, as in the case of the former. In hard steel the surfaces present a rough crystalline appearance, while in soft steel they have the glossy appearance of woven silk, or bundles of fine silk fibres. Although the character of the fracture is always noted in connection with the other data derived from the test, it is seldom made an important requirement in specifications owing to the impossibility of determining a fixed standard of comparison. Compression tests are made by the same machine in slightly different arrangement so that the hydraulic power is pressure instead of pull.

Cold bending tests are useful for the purpose of determining the ability of steel, or any other metal, to withstand severe distortion, when the metal is cold, under such operations as punching, shearing, flanging and riveting, usually employed in the manufacture of bridge members and structural shapes in general. The test does not require an expensive or elaborate plant for its application, and is, therefore, available where more complete tests are impracticable. On the other hand, however, it is very difficult to deduce accurate conclusions from the data obtained, owing to a lack of proper classification and standards of comparison. In making the test, the metal in each case is bent over upon itself through an angle of 180 degrees. The inner radius of the bend varies from 0, in steel with a tenacity less than 62,000 pounds per square inch, to the «thickness of the specimen» in steel with a tenacity not greater than 70,000 pounds per square inch. The specimen is required to stand the bending without fracturing on the outside of the bend. The test for hardness is applied by pressing or driving a hardened steel ball into the material so as to produce a dent. The diameter of the ball used is commonly 10 millimeters and the standard pressure used is 3,000 kilograms. The diameter of the indentation is then measured. Two indentations are usually made not far apart on the specimen being tested. The formula applied is $\frac{16\,PD^{n-2}}{\pi(2d)^n} \times \frac{1}{1.0718}$; this giving the hardness number in the Brinell scale. It has been objected to these ball tests that the tendency of the pressure is to raise up a cup-shaped rim of steel around the ball and above the level of the test specimen, and that the diameter measured will thus be of the raised cup. To obviate this a delicate instrument has been devised to measure the depth of the indentation below the level of the tested surface, and from this to calculate the true diameter. Another method of applying this ball test is by a falling hammer which carries the ball upon its face. The standard weight of the hammer is 1.76 kilograms, and the drop may be any distance up to 90 centimeters. Several tests are made at different falls, and the results correlated. A variation of this test substitutes a cone-shaped point with an angle of 90 degrees for the spherical ball. This also is applied by a standard pressure or by the falling hammer, and a closer accuracy is claimed. As determined by these methods the Brinell hardness numbers for the commoner grades of steel are as follows:

Mild steel	120.
Boiler plate	128.
Rail steel	183.
High carbon steel	236.
Cast iron	213.

Another method of testing steel of great accuracy in the hands of an expert is the "spark test." This is applied by pressing the sample of steel for an instant firmly against a sharp emery wheel revolving 7,000 feet per minute. To the educated eye the kind of sparks emitted indicate with great certainty not only the proportion of carbon in the sample, but the several alloys with tungsten, manganese or chromium.

Other tests are made for endurance of steel samples, especially that used in the automobile industry. Such steels are tested for fatigue, being subjected again and again times without number to the same kind of strain, and also to shocks which they must safely withstand in the ordinary use of a car. These tests are applied by automatic machines acting unceasingly for many hours. Another test of great importance in automobile steel is the abrasion test for wear.

In some cases torsional and shearing tests are made, but these stresses are not commonly expected. The impact test is more often employed, applied by means of a heavy, swinging pendulum, or by an oft-repeated drop of a weight upon a bar supported at the ends. The tests of finished steel are similar to those made in the mills during the process of manufacture, with the exception of the methods employed in the preparation of the test specimens. These are cut directly from the finished product in the form of rectangular pieces 10 inches in length, in the larger kinds of work, while small bars are generally tested full size. Consult Bullen, D. H., 'Steel and Its Heat Treatment' (New York 1918).

STEEL, THEORIES OF HARDENING.

That steel has the property of hardening when suddenly cooled from a bright cherry heat has been known for centuries. The origin of steel hardening cannot be traced definitely, but Homer refers to it and Pliny, the Younger, describes a method which, in its main points, is general practice to-day. (Otto Vogel in *Stahl und Eisen*, 1899, p. 242). During the 15th and 16th centuries the practice grew to be an art and great secrecy and superstition were attached to it. Quaint and curious methods were evolved and the secret was hoarded and handed from generation to generation. Even to this day, in some sections, the same old type superstition exists among some of our own blacksmiths, and it is quite common to meet with one whose ideas and practices are identical with those followed in the Middle Ages.

Many of the mechanisms of what happens during the process known as hardening have been studied and are known, but the real reason of why steel hardens is still in doubt. The very fact that there are at least seven distinct theories, in vogue to-day advanced by as many eminent metallurgists, is mute evidence of the fact that we are in the dark regarding this reason. Sir Robert Hadfield (Farady Society, November 1914) in discussing these theories says: "I cannot say that there is one which throws light on what really happens when a piece of carbon steel is changed from a soft to a hard condition." Dr. J. E. Stead (Farady Society, November 1914) expresses the opinion, "We have not sufficient data upon which to found any definite conclusion as to the process known as the hardening of steel by quenching," and Albert Sauveur (International Engineering Congress, September 1915, San Francisco), "It will likewise be obvious that no theory so far presented fully satisfies our craving for a scientifically acceptable explanation of the many phenomena involved." H. M. Howe (Farady Society, November 1914) says "Each of these theories has its difficulties," and Rosenhain ('Study of Physical Metallurgy,' p. 180) says regarding Martensite (the normal constituent found in normally hardened steels), "The question 'What is Martensite?' cannot be answered quite conclusively, particularly as several rival views are in the field."

In the usual practice followed in hardening a piece of ordinary carbon steel the operation is an extremely simple one. It consists of heating the piece to a predetermined temperature, holding at this temperature for a length of time sufficient for the entire mass to be evenly heated and then suddenly cooling it. The cooling is usually done by immersing in a liquid, usually water or oil.

The simplest steel has at least two constituents, one iron or ferrite, and the other a carbide of iron or cementite, and, in order to gain an inkling of what transpires, it is necessary to study the properties of these two constituents.

If we plot a cooling curve of pure iron, we find that at 898° C. and 768° C. marked evolutions of heat occur, indicative of a change in the physical properties (see Fig. 1), while, if carbon be present, as in steel, a third evolution of heat occurs at 690° C. (see Fig. 2).

Floris Osmond (*Journal Iron and Steel Institute*, No. 3, 1906, p. 444), in a series of brilliant researches first brought out the momentous discovery that iron exists in three separate and distinct allotropic modifications. At all temperatures up to 768° C. pure iron or ferrite exists in the Alpha condition. Between this temperature and 818° C. it is in the Beta condition, and above 898° C. it exists in the Gamma condition. In each of these three conditions the physical properties are entirely distinct. Crystallographically, they are all of the cubic system, but the Gamma iron assumes the octahedra while the Beta and Alpha assume the cube. Twin crystals are frequent in the Gamma, but the Beta and Alpha are free from them. Alpha iron is magnetic, and the change from Alpha to Beta is accompanied by an abrupt change in the electrical conductivity, strength and hardness and crystalline form. On cooling, changes occur which are the reverse of, and appear at very nearly the same temperatures as, those on heating. The points on heating are known as the AC_3 and the AC_2; on cooling, as the AR_3 and the AR_2. When carbon is present, a third evolution on cooling takes place at about 700° C. which is known as the AR_1 and the reverse as the AC_1. The ranges in which these changes occur are known as the critical ranges.

The carbon in steel exists in the form of a definite chemical compound known as cementite which has the chemical formula Fe_3C. It crystallizes usually in flat plates or needles which in some cases coalesce into the form of granules. It is the hardest constituent of steel and is attacked by ordinary reagents less than the other constituents.

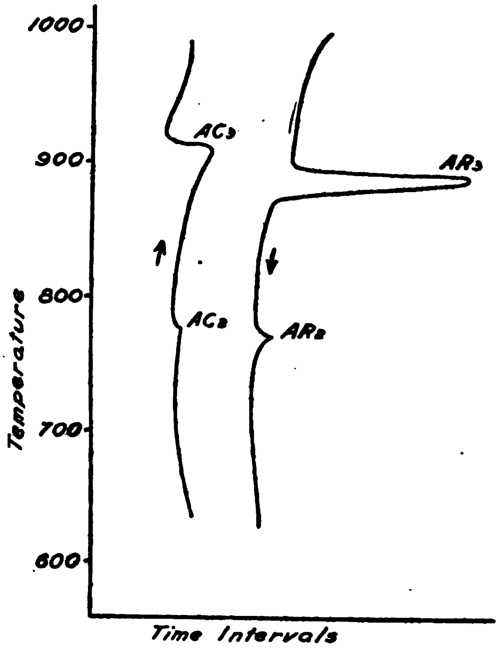

FIG. 1.— Inverse Rate Heating and Cooling Curves of Pure Iron. (Burgess and Crowe, Transactions American Institute Mining Engineers, XLVI, 1913).

Cementite and ferrite are the two most important constituents of steel, and it is, therefore, their inter-relation which we must study in order to understand what is transpiring, constantly bearing in mind that the ferrite can and does exist in three different allotropic conditions depending upon the temperature. At ordinary temperatures cementite and ferrite exist together as completely decomposed constituents, and, in the lamellar condition, arrange themselves in tiny flakelets. Upon heating to the Gamma range of temperatures, cementite dissolves in the Gamma iron with the result that there is formed a constituent known as austenite. In only special cases can this be preserved at ordinary temperatures because it is extremely unstable and breaks down into martensite, this latter being the usual constituent found in ordinary hardened steel.

There are two sharply defined schools attempting to explain the problem of hardening, and below is given classification in tabular form. (Sauveur, 'The Metallurgy and Heat Treatment of Steel,' p. 308).

- I. RETENTION THEORIES
  - A. Solution theories
    - a. Beta iron or allotropic theory, Osmond.
    - b. Alpha iron theory, H. LeChatelier.
  - B. Amorphous iron theory, Humphrey.
  - C. Carbon theories
    - a. Hardening carbon theory,
    - b. Sub carbide theory, Arnold.
- II. STRESS THEORIES
  - A. Early stress theory, Andre LeChatelier.
  - B. Interstrain theory, McCance.
  - C. Twinning and amorphous iron theory, Carpenter and Edwards.

I. *The Retention Theories* base their ideas on the claim that a condition or set of conditions existing normally above the critical range are, by sudden cooling, retained as such or a transformation therefrom, which state is unstable and, upon tempering or reheating, tends to revert to the original or normal condition.

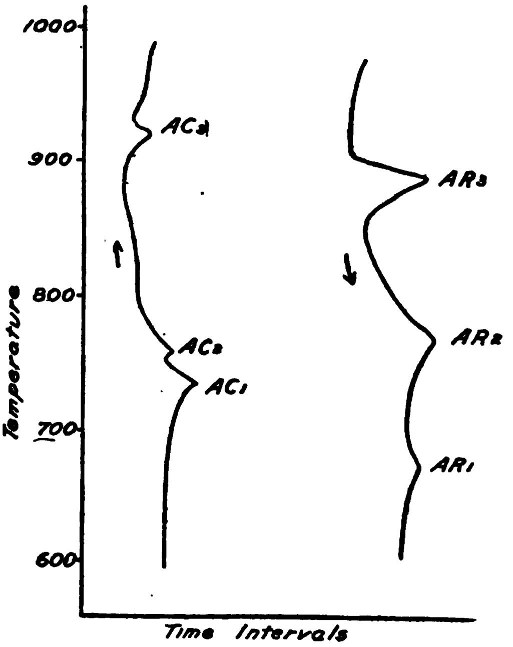

FIG. 2.— Inverse Rate Heating and Cooling Curves of Mild Steel. (.106 Carbon) (Rosenhain and Humphrey, Journal of the Iron and Steel Institute, LXXXVII, p. 232).

IA. *The Solution Theories* claim that the constituents or a part of the constituents existing normally at ordinary temperatures, on heating pass into a solid solution and are retained in this state upon sudden cooling. The idea of one solid dissolving another solid may be new to some readers but under certain conditions this is true. As an example, gold and silver are mutually soluble in each other in all proportions.

IAa. *The Allotropic Theory* claims that the hardness of steel is due to the presence of Beta iron. The followers of this theory believe that, on heating, the cementite dissolves in the Gamma iron and, on sudden cooling, the Gamma iron immediately breaks down, forming a certain amount of Alpha iron but mostly Beta iron which still retains the cementite in solution. They believe that the cementite in solution simply (as Howe puts it) acts as a brake on the Beta iron and prevents it from entirely reverting to the Alpha iron. Were it possible to obtain Beta iron by means other than the solution of the cementite, the material would still be hard. The allotropists are also of the opinion that, in the transformation from the Gamma to the Beta, the internal pressure may contribute to the final hardness.

IAb. *The Alpha Iron Theory* denies the presence of Beta iron entirely, and explains that the hardness is due to the fact that, on cooling, the Gamma iron with the cementite in solution changes directly to the Alpha form, which latter still retains the cementite in solution. This theory has little or no standing, since the careful and thorough experiments of Dr. G. K. Burgess (Bureau of Standards, Scientific Paper, 1914) have proved conclusively the presence of Beta.

IB. *The Amorphous Iron Theory* was brought out by J. C. W. Humphrey and seconded by Rosenhain (Rosenhain, 'Study of Physical Metallurgy,' p. 181). The followers of this theory believe that the hardness of steel is due to the presence of an intrinsically hard but unstable product, amorphous iron. "The Gamma iron crystals, in passing through the transition temperature, break up, leaving the molecules temporarily in a chaotic (amorphous) condition pending their reorganization into crystals of Alpha iron and cementite, and it is only this rearrangement which is stopped by the rapidity of cooling." Rosenhain believes further that the breakdown of the Gamma crystals occurs only around the boundaries of the growing crystals of Alpha iron.

IC. *The Carbon Theories* claim that the hardness is due to the retention in the cold of a very hard form of carbon.

ICa. *The Hardening Carbon Theory* claimed that the hardness of steel was due to the presence of hardening carbon, which was stable only above the critical range. This theory is now pretty much discredited.

ICb. *The Sub-Carbide Theory.*—Arnold believes in the existence of a carbide Fe_xC, which he has named hardenite, and that it is due to the retention of this constituent that steel owes its hardness. He establishes the identity of this carbide by an indirect method and the theory has little support to-day.

IIA. *The Early Stress Theory.*— When steel is heated to its critical range it expands at a rate which is approximately directly proportional to the temperature change. On passing through the range it contracts. Then, on heating above the range, it again expands, but at a rate greater than it did before. (LeChatelier, 'Contribution to l'Etude des Alliages,' p. 386). On cooling, the reverse occurs and the stress theories attempt to explain the hardening as being due to the immense strains set up thereupon.

IIB. *The Interstrain Theory.*—McCance says (*Journal of the Iron and Steel Institute,* 1914, No. 1, p. 233): "On quenching steel the carbon is retained in solution and, in turn, it retains a portion of the iron in the Gamma condition, but the majority of the iron is Alpha iron. At the quenching temperature, the crystalline grains had the crystalline symmetry of Gamma iron, and the Gamma iron retained in the quenched state by the carbon will form an internal network in these original steel grains. The units of the iron will be transformed and will form crystal units of Alpha symmetry, but these will be prevented by lack of time, by internal friction and by the Gamma iron network from arranging themselves to form homogeneously orientated Alpha iron crystals. The Alpha iron will thus be in a condition similar to interstrain and great hardness will result."

IIC. *The Twinning and Amorphous Iron Theory.*— Professor Carpenter and Edwards advance the theory that "In the operation of quenching, the normal heat of the carbide or other similar change is retained in the rapidly cooled material and, when the change is suppressed in this way, severe internal stresses are set up and these cause internal straining of the material." That this is a fact is proved because the "Metallic crystals are broken up into an exceedingly large number of twin lamellae."

There is a further type of hardness which is common to metals including steels which is different in many respects from the hardness produced by sudden cooling. This is the well-known hardening effect of cold working, such as hammering, swedging or cold drawing.

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STEEL ALLOYS. See CHEMISTRY, PROGRESS OF; STEEL, SPECIAL OR ALLOY.

STEEL ARMOR PLATE. See ARMOR PLATE.

STEEL BRIDGES. See BRIDGE CONSTRUCTION, MODERN METHODS OF.

STEEL CAR INDUSTRY, The. The building of steel railroad cars is recognized as one of the most prominent of our industries. European countries were pioneers in the use of iron cars, and as early as 1861 we find records of cars with iron bodies being built in France, while in India, iron was substituted for wood at an early date, as the latter material was particularly susceptible to the attacks of ants and other insects, which condition necessitated the use or iron or steel in the construction of equipment for use on the railroads of that country. In other foreign countries the selection of iron for this purpose was undoubtedly governed largely by the comparative cost of iron and wood, which in many instances favored the use of the former material, and also for the reason that climatic conditions in many of these countries are such that wooden cars rapidly disintegrated. To the American engineer, however, should be given the credit of foreseeing the possibilities of steel in car construction, not solely from a constructive standpoint, but as a scientific solution of the problem of economical transportation. The successful operation of a railway is dependent on the relative cost of transportation, and the use of steel in car construction has made it possible to decrease to the minimum the percentage of dead weight to that of paying load. The progress made in the proper appreciation of the stresses to which the different parts of a car are subjected has resulted in great improvements, providing ample strength for the duties imposed on the several parts, eliminating superfluous material where it may be done without detriment to the car as a whole, thus producing, in steel, cars of minimum weight and maximum strength. This favorable comparison of percentage of dead weight to paying load is much more evident in the higher capacity cars, where the full benefit of the difference in strength between wood and metal may be realized.

The capacity of freight cars in this country has been continually on the increase, and constant efforts are being made to reduce the relative proportion between weight of car and weight of lading. Up to 1876 the average freight car had a carrying capacity of 20,000 pounds, while the ratio of paying load to total weight of car and lading was about 47 per cent. In 1880 the capacity had been increased to 40,000 pounds, and the ratio of paying load to 60 per cent; in 1883 to 50,000 pounds and 65 per cent; in 1889 to 60,000 pounds and 66 per cent; in 1895 to 80,000 pounds and 68 per cent; and in 1903 to 100,000 to 110,000 pounds and 75 to 79 per cent, respectively.

In the catalogue of all-steel cars manufactured in 1918, the largest load capacity is that of the 120-ton gondola car. It is 50 feet in length, 9 feet 8 inches in width and with walls 7 feet 4 inches high above the floor level. This car weighs about 74,000 pounds and with its full load represents a total weight of 314,000 pounds — the paying load approximately 77 per cent. The standard all-steel 50-ton box (freight) car varies in weight from 43,100 pounds to 52,600 pounds. It ranges in inside length from 36 feet to 40 feet; from 8 feet 6 inches to 9 feet in inside width, and from 8 feet 4 inches to 9 feet 2 inches in inside height. The higher weight car carries a paying load of 70 per cent of the total weight; the heavier car a paying load of about 66 per cent. Hopper cars for coal carry 100 tons upon a car weight of 60,000 pounds to 75,300 pounds, the paying load thus ranging from 77 to 73 per cent of the total rolling weight. The 100-ton flat car and the 110-ton well-hole car, weighing respectively 90,000 pounds and 92,000 pounds, have still lower paying efficiency. However, when durability is considered, the heavy cars are more economical in the long run, and with their far greater burden serve to roll up the record of ton-miles with far greater rapidity than the light car of smaller burden. The modern all-steel passenger coaches range in weight from 116,000 to 146,000 pounds, and the dining-cars, the heaviest of all standard coaches, reach 175,000 pounds.

The general introduction of the steel car was not accomplished without serious opposition; first, from those who were directly interested in the manufacture of wooden cars; and second, from those who were skeptical as to the advisability of adopting steel as a vehicle of transportation, exposed to the action of injurious elements which might cause a rapid deterioration of the metal and a consequent reduction in strength. However, up to the present time no serious effects from this cause can be noticed in the cars now in service. If proper attention is given to the method of construction and weight of metal used, and all parts are thoroughly painted at the time of manufacture to protect them from corrosion, and if after the cars are placed in service care is taken to repaint them when necessary, it is fair to presume, judging from the present condition of the earlier steel cars built in this country, that we may reasonably expect an average length of service from the steel car of at least 30 years, or fully twice as long as the service obtained from cars of wood construction.

The steel car industry may be correctly said to date its origin in this country from the year 1896, although the records of the Patent Office show that patents were granted to citizens of this country, as well as of foreign countries, for cars made entirely of steel or other metal, as early as 1854, and it is also true that prior to this time cars of metal, or a combination of metal and wood, had been constructed and put in service in this country; but these early efforts had little in common with the modern steel car, now standard on many of our leading railways. Previous to the year 1897 many cars had been constructed in this country of steel or iron, but were built for special service by the several railroads, mainly for the purpose of facilitating the transportation of heavy materials, where the load was more or less concentrated, such as wire cables, guns, bridge girders, etc. In the design of such special equipment no particular attention was given to the consideration of a reduction of the weight of the component parts, with the result that most of these earlier metal cars were excessively heavy and not suitable for general service.

Iron-box cars were used as early as 1862, these having been built by the Baltimore and Ohio Railroad and weighed 18,000 pounds, with a capacity of 30,000 pounds. Later, in 1869, the Lake Shore and Michigan Southern Railroad placed in service flat cars with iron channel sills, and the New York Central and Hudson River Railroad had several metal cars running on its road as early as 1873. In these cars the substitution of iron for wood was more particularly confined to the underframing of the car, the superstructure, if any, being of wood. In connection with these early types of metal underframes mention may also be made of steel underframes for carrying water tanks of locomotives, which were in use as early as 1881.

It was not until 1887, however, that metal underframe cars were placed in service in any considerable numbers, these being built under patents owned by the Southern Iron Car Company, who constructed several thousand steel-underframe freight cars, including box cars, hopper bottom gondola cars, flat cars, etc. These underframes were of the iron tubular type, being formed by the assemblement of different sizes of wrought-iron pipe, tied together by means of threaded connections, so as to form a light and compact structure. However, in actual service it was found that the connections would rapidly loosen, thus destroying the strength of the whole, and after only a comparatively short time the construction of cars of this type was entirely abandoned. From this time on numerous experimental cars with steel underframing were built, but the unsatisfactory results derived from the tubular underframe undoubtedly retarded the adoption of the modern type of steel underframe car. The Pennsylvania Railroad in 1887 built a number of cars having steel underframes which were designed to carry a concentrated load of 120,000 pounds, and a steel fireproof car was built in 1889 at the shops of the Louisville, New Albany and Chicago Railroad. The Chicago, Burlington and Quincy Railroad, about the year 1890, placed in service a steel car of 60,000 pounds capacity, constructed from designs of the Harvey Steel Car Company.

In 1894 the Carnegie Steel Company ordered from the Fox Solid Pressed Steel Equipment Company, of Joliet, Ill., a number of steel-flat cars of 80,000 pounds capacity, to be used in service about its mills for the transportation of heavy billets. These were built entirely from pressed steel shapes and embodied in their design special features of pressed-steel work, being similar in this respect to cars then being built by the Leeds Forge Company of England, both the Fox Solid Pressed Steel Equipment Company and the Leeds Forge Company being controlled by Sampson Fox, who was the originator of pressed-steel shapes in car construction. Up to this time, 1894, the possibilities of the use of steel in car construction, it is fair to state, were not fully appreciated by those controlling the design and operation of railroad equipment, and to the Carnegie Steel Company should be given the credit for properly placing before the railroad world the possible advantages to be derived from the use of an all-steel car. The interest displayed by the Carnegie Company was no doubt largely the result of a desire to increase the demand for its product by providing additional avenues for the consumption of steel plates and shapes. The arguments at the time set forth in favor of the use of steel for freight-car construction, and all which claims experience has since verified, were lightness, durability, strength, greater proportion of paying load to total weight of car, reduced cost of maintenance, less liability to damage and greater salvage value.

To further exploit the possibilities of steel in car construction the Carnegie Steel Company in 1896 had built at the Keystone Bridge Works three all-steel cars, one of these being a steel-flat car and two self-clearing hopper cars, in which the floors are inclined from the ends downward toward the centre and at the bottom of these inclines doors being provided, which, when opened, permit the load to discharge by gravity. These cars were exhibited at the conventions of the Master Car Builders and Master Mechanics' associations, held at Saratoga in June 1896, and elicited the interest of car builders and railroad men throughout the country. Rolled plates and shapes, which could be purchased in the open market and all of which constituted the product of the Carnegie mills, were used in the construction of these cars.

Previous to this time the Schoen Pressed Steel Company, of Pittsburgh, Pa., had for a number of years been manufacturing various parts of cars by pressing plates into special shapes. This company was the first to introduce a design of an all-steel self-clearing hopper bottom coal car built entirely from pressed shapes, these being built under patents issued to C. T. Schoen and J. M. Hansen. The prompt and extended adoption of the all-steel car is undoubtedly due to the aggressive policy pursued by this company and its successor in the introduction of its product. The designs for these cars were placed before railroad engineers shortly after the exhibit of the cars built at the Keystone Bridge Works for the Carnegie Steel Company. The Carnegie Steel Company, owning and operating the Pittsburgh, Bessemer and Lake Erie Railroad, extending from Pittsburgh to Lake Erie, decided to place in service on this road enough cars to thoroughly demonstrate the possibilities of cars built of steel, and early in 1897 placed with the Schoen Pressed Steel Company an order for 600 self-clearing steel hopper cars of 100,000 pounds capacity, it being specified that 400 of these cars were to be of the structural design originally prepared by the Carnegie Company's engineers, and 200 to be of the pressed steel design advocated by C. T. Schoen. At the time of the placing of this order, it may be interesting to note that there was no industrial establishment in the country specially equipped for the construction of steel cars and the Schoen Pressed Steel Company was not able to turn out one complete car per day. Upon being awarded this order, however, those interested in the Schoen Pressed Steel Company, of which C. T. Schoen was the executive head, immediately arranged for the extension of its plant and carried on the work of enlargement simultaneously with the construction of the cars, with the result that the entire order for 600 cars were completed in nine months, the first car having been completed in June 1897.

Following the order of cars for the Pittsburgh, Bessemer and Lake Erie Railroad, the Pittsburgh and Western Railroad placed with the Schoen Pressed Steel Company an order for 450 pressed steel self-clearing hopper cars of 100,000 pounds capacity. These two orders marked an epoch in car construction and railway freight transportation and the steel car industry was firmly established, and has since grown with phenomenal rapidity. As already stated, the cars for the Pittsburgh, Bessemer and Lake Erie Railroad were of two different designs, one employing rolled sections and the other pressed shapes. As both were along radically different lines from previous designs of either wood or metal cars a general description of both types may prove of interest.

The cars designed by the Carnegie Steel Company were what is known as the hopper bottom type of car, the cubical capacity being about 1,400 cubic feet. The centre sills consisted of two 15-inch I beams, and the side sills were 12-inch channels with their flanges placed inward. No intermediate sills were used. The plates forming the sides of the car extended to the bottom of the side sill channels, and were riveted to the web of same. This latter form of construction was employed on the first sample car, but on later cars was modified by omitting the channel side sills and riveting an angle along the lower edge of the side plates, a second angle being riveted to the plates about 18 inches higher up, both angles extending the full length of the car. The body bolster was of a built-up latticed girder type, and the floor of the car was made up of inclined steel plates and a cross-hood placed at the centre of the car. This car weighed about 37,150 pounds. The car made of pressed steel was similar in general appearance to the above described car, but differed materially in the details of construction. The centre sills were made of plate, pressed to channel form, being 17 inches deep at the centre and tapering to 10 inches deep at the bolsters. The side sills were of similar construction, and the side plates were flanged at both top and bottom, the bottom flanges being riveted to the top flanges of the side sills. The body bolsters also were of pressed steel, being trough-shaped in form. This car weighed about 34,350 pounds.

At about the time the order for the Pittsburgh, Bessemer and Lake Erie cars was placed the Pittsburgh and Lake Erie Railroad was designing a hopper car along somewhat similar lines to the cars designed by the Carnegie Steel Company, and a sample car in accordance with these designs was built by the Youngstown Bridge Company, this car being completed and placed in service about March of 1897. In this car the centre sills consisted of 15-inch I beams, the sides of the car being built-up plate girders, with diagonal reinforcing angles extending from top to bottom and stiffening angles extending the length of the sides being riveted to the upper and lower edges, thus forming a girder which was designed to carry the entire load. In order to reduce the weight of the car the side sheets below the floor line, from the bolsters to the ends of the car, were cut out. This car was of 100,000 pounds capacity and weighed 35,500 pounds. No pressed shapes whatsoever were used in its construction.

Up to this time all the cars built by the Schoen Pressed Steel Company were of the hopper bottom type, but the value of steel in freight car construction having been fully demonstrated, orders for other types followed in rapid succession, so that to-day practically all forms of freight cars, including hoppers, flat bottom gondolas, flat and ballast cars, have been constructed from steel in large numbers.

The adoption of the idea of maximum train loads, and the consequent enormous increase in the tractive power of the locomotive, served to further increase the popularity of the steel car, as it early became evident that the draft rigging and underframe construction of the wooden car would prove inadequate for the severe service to which they were subjected. As a consequence many cars of the box, stock and gondola types were built with steel underframing and having a superstructure of wood as a substitute for the original all wood structure. Cars of this type have given very satisfactory results in service, as with the combination all the desirable features of the wooden body are retained, while the undertrame is sufficiently strong to resist the most severe buffing and pulling strains. A further advance in the substitution of steel in cars of the combination type has recently been made by the use of steel posts, braces, plates and carlines as a substitute for those of wood, thus producing a complete steel frame car.

The successful results obtained from the introduction of rolled steel as the basic material in many large engineering enterprises warranted its careful consideration in the infancy of steel car construction, and when the Carnegie Steel Company specified that the major portion of its first order for steel cars was to be constructed of rolled section, it is evident that from the very beginning it was recognized that the ideal car would be one made throughout of standard commercial shapes. As pressed steel, however, admitted of the production of shapes of the exact form desired, and the early development of the steel car being in the hands of those predisposed in favor, and interested in the manufacture, of pressed steel parts, it is natural that great progress was first made in the perfecting of this latter type of construction, while the car made of rolled sections remained for the time in its original crude state, being clumsy and heavy when compared with the more highly developed pressed steel car. The advantages of constructing a car from a few standard commercial shapes, easily obtained in the open market, especially when considering the question of repairs, rather than from numerous special parts, requiring expensive machinery in their manufacture, were too manifest, however, to permit of being long ignored, and that it was possible to build cars from standard rolled sections, having all the advantages of light weight and maximum strength claimed for the pressed steel car, has been fully demonstrated by the later developments of the art, and is amply evidenced by the numerous structural steel cars now in service which compare favorably with the pressed steel types in the matters of lightness, strength and simplicity of construction.

With the increasing demand for the steel car it is natural that a very inviting field for the investment of capital was disclosed, with the result that we have to-day in the United States a score of large corporations actively engaged in this line of manufacture. The Pennsylvania Railroad builds its own steel cars, both passenger and freight designs; and several other railroads build freight cars for their own use. Besides the very large domestic trade the steel car builders have developed a profitable and growing export trade which is destined to be much larger in the near future, as the Belgium production, heretofore the chief competition in the foreign markets, must necessarily be small for several years to come.

J. M. Hansen,
President, Standard Steel Car Company.

STEEL ENGRAVING. See Engravings.

STEEL INDUSTRY IN THE UNITED STATES. See Iron and Steel Industry in the United States.

STEEL NAILS. See Nails; Steel Wire and Nail Making.

STEEL PIPE. See Pipe, Manufacture of.

STEEL RAILS. See Rails and Structural Shapes.

STEEL SKELETON CONSTRUCTION. See Building in the United States.

STEEL STRUCTURAL SHAPES. See Rails and Structural Shapes.

STEEL TUBE. See Pipe, Manufacture of.

STEEL TUBING. This is the most modern and one of the widest used products of steel. For many years steel tubing was not considered entirely satisfactory by manufacturers because the welded parts were not as strong as the rest of the tubing. This difficulty has been overcome and to-day steel tubing finds a remarkable market in the manufacturing of automobiles, engines, furniture, baby carriages, beds, boilers, etc. Steel tubing is made from solid or hollow billets or from steel ribbon.

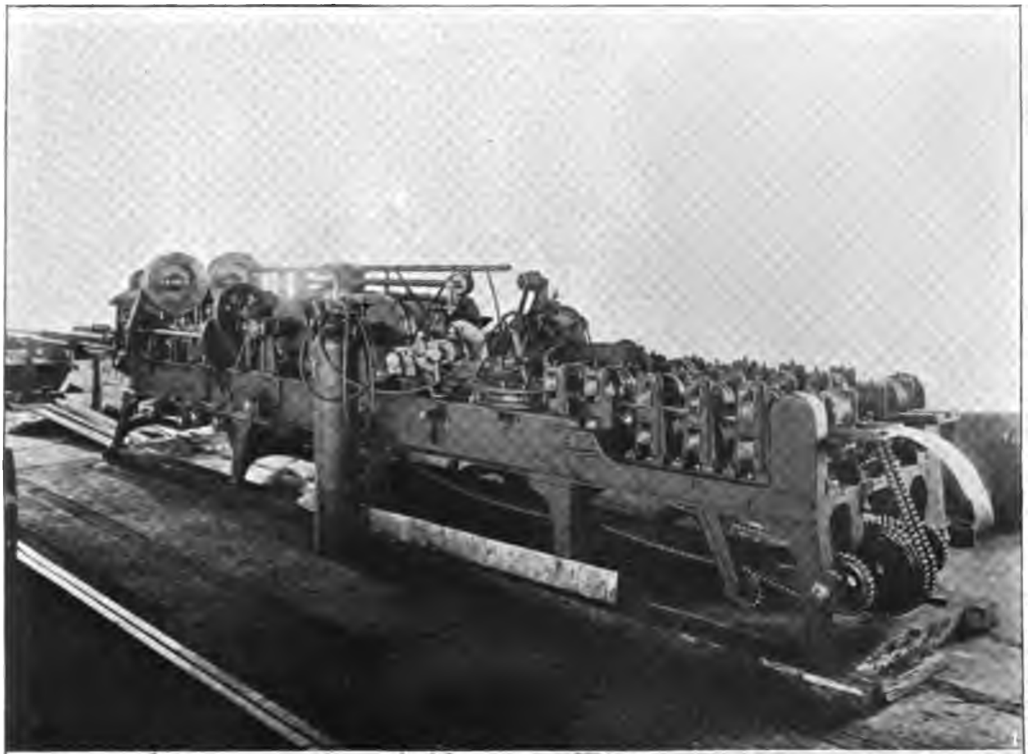
Technology.— There are four methods of manufacturing steel tubing, i.e., lap welding, butt welding, the piercing method and the Lloyd oxy-acetylene method. The lap method has been in vogue for many years, dating back to the period when steel first began to be used. The early manner of lap welding was known as spiral welding. Steel sheets of a desired width were wound spirally to form a tube. The spiral joints were heated and welded by a hammer, although in many cases these joints were cold riveted. An even earlier method of making steel piping was to take two semi-circular pieces of steel and insert the edges into steel bars with grooves in either side. These were held in place by pressure applied on all sides. There was no welding or joining of the semi-circular pieces and the piping thus made was useless except for underground purposes or in such places where the pressure could be applied at all times. Later came the straight lap welding, where flat steel of a desired width was passed through rolls, drawn over dies and formed with the edges overlapping. Heat was applied and the overlapping edges were hammered or squeezed together. This left the welded part thicker and stronger than the rest of the tube and was never satisfactory for good manufacturing work. In a later method — the flat steel ribbon was heated and the edges were scarfed or bevelled by passing through rolls, drawn through dies and so formed that the scarfed or bevelled edges of the one side of the flat steel fitted into the same edges of the other side. This partly-made tubing was then reheated, passed through rolls with the inner lap resting on a stationary mandrel. The rolls and the mandrel pressed the heated steel together and welded it. The rough tubing was then passed through sizing rolls, straightened, rolled on cooling tables and finally forced through straightening machines by hydraulic pressure. Butt welding then came into use, the first process requiring that the entire piece of flat steel be heated to a welding heat and drawn through a conical shaped die, so that square edges were pressed together. Then came the brazing process of butt welding, in which a blow-torch like that of a tinsmith, only with far greater heat, was used to centralize the heat at the square edges where the brazing is to take place. The brazing method is used when very thin tubing is to be made because the heat of the blow-torch is not sufficient to make thicker steel tubing. It is largely used in brass or copper welding, where a heat of from 1,200° to 1,400° is required, while steel needs from two and one-half to several times that heat. The electric process consisted of heating the edges and applying pressure so that the steel is pushed together and welded at the same time. Flat steel is put through conical shaped rollers, bringing the edges of the steel together at the point where electric heat is applied. As the steel is heated the rollers press the edges closer together. This was a decided improvement over other processes of butt welding, but the greater strength and thickness of the welded part made several other processes of rolling, etc., necessary before the tubing was ideal.

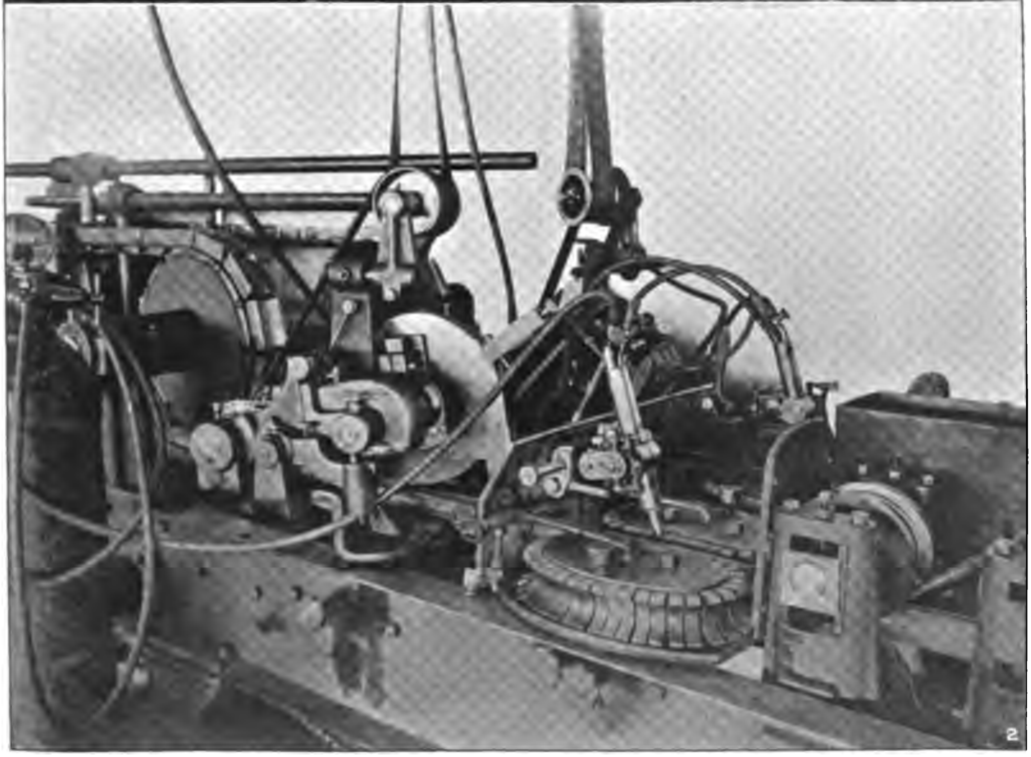
The piercing seamless method is the latest and most efficient for producing heavy steel tubing. Solid or hollow billets are heated to about 2,300° and passed through diagonal rolls traveling at a tremendous speed. These rolls work the steel into desired size. While the billet is passing over the rolls it is pushed against a mandrel which is stationary but revolving 2,400 times per minute. The billet is thus worked into a desired size with a hole through the centre and comes through a tube after many operations. For example, if a two-inch tubing 46 inches long is desired, a billet three inches round and 26 inches long is heated, passed through the diagonal rolls and at the same time has the mandrel passed through it. When this operation is completed the tubing measures three and one-half inches on the outside with a seven-sixteenths shell. It is then taken to the round rolls where it is elongated and the shell reduced. Then it is cold drawn, hot rolled, pickled, cold drawn, annealed and so on. The lighter the shell desired the more operations necessary. The piercing method found itself very applicable to the hollow steel billet made first in Sweden, where the molten steel was poured over a core, the latter removed when the steel shell had cooled, thus leaving a round billet with a rough hole through the centre. This made it possible for the piercing method to become much speedier in production.

The Lloyd oxy-acetylene is the latest method of producing thin gauge steel tubing. Until this method was invented thin-gauge tubing was exceedingly costly in comparison to larger gauge tubing, owing to the many more treatments required in order to get a thin-walled tube. The Lloyd oxy-acetylene method requires steel ribbons of desired widths. The ribbons are passed through oval-shaped rollers, thus bringing the square edges close together. The partially shaped tubing then passes to other rollers which press the edges very close together. At this point oxy-acetylene heat is applied at about 2,500° and the welding takes place. It is then polished, cut off to desired lengths and comes out of the machine ready for use. A single machine accomplishes the entire work. The Lloyd oxy-acetylene method differs from the butt welding in that the steel edges are not pressed together and only a very small portion of the partially shaped tubing is heated. So delicate is the operation that a seamless tube is produced in desired lengths without waste.

History.— While the use of iron and steel has become so common in mechanical and structural work as a result of modern ingenuity, it is hard to realize that nearly five and one-half centuries passed by after the discovery of iron before steel became a commercial product. Iron was first found, say historians, in the pyramid of Gizeh, where it had been placed by builders, most likely as a relic. This same iron to-day rests in the British Museum. So far as is known iron was used commercially for the first time by Assyrians in Egypt. They made various kinds of tools, etc. History shows that for some time before the coming of Christ iron was used in making the implements of war, tools and other articles. It was not until 1350, however, that cast iron

STEEL TUBE WELDING





1 The Lloyd Oxy-Acetylene Steel Tube Welding Method and Machine, the only machine in the world that takes flat ribbon steel, rolls it into a tube, welds it, polishes it and cuts it off to proper lengths ready for use. Note ribbon steel passing into rollers in front of photograph

2 The Lloyd Endless Vise, showing how endless tubing can be carried through it to the welding torch, the latter being shown with its nose between the two endless vise wheels

and steel first made their appearance, when a German metallurgist produced them. The inventions of the Bessemer process for manufacturing steel opened this metal up to commercial use. This took place in 1855. The use of steel became an important product in mechanical and manufacturing history very soon after processes for preparing it were invented. The first known use of steel as a tube or pipe is the Coolgardie pipe-line, 328 miles long and 30 inches in diameter. This pipe was not welded. It was formed by taking ribbon steel and bending into semi-circular shape. The edges were inserted into steel bars with grooves on either side. Heavy pressure was applied on the plates and bars, thus rendering the pipe serviceable. Steel tubing itself was one of the very latest uses of steel owing to the early inability to make welded steel tubing so that the welded portion was of the same strength as the rest of the tube. Later, just the opposite condition arose, but to-day the piercing and Lloyd oxy-acetylene methods have overcome all these objections. The early lap and butt welding methods were not satisfactory for high-class work, and it was not until Mannesman Brothers, German by birth, but residents of Landore, Wales, and backed by British financiers, brought out the piercing method. They took round or square steel billets and pierced and rolled them to the size desired. This was a seamless method in which no welding was required and, therefore, gave great impetus to steel tubing uses. Improvements on the Mannesman method have been made by W. C. McCool of Beaver Falls, Pa., he being the first to invent a cold draw bench for drawing cold shafting. R. C. Steifel made other improvements at Ellwood City, Pa. He followed these with new improvements at Shelby, Pa., while George J. Thust added more at Detroit and Milwaukee, where mills were built in which the piercing method was used. The great difficulty of the piercing method arose when thin-gauge tubing was required, for the thinner the gauge the more rolling and drawing required. These many operations made the cost of thin-gauge tubing almost prohibitive. It was not until 1910 that Marshall B. Lloyd of Menominee, Mich., solved the problem of the thin-gauge, seamless steel tubing. High prices, long delays and imperfect thin-gauge tubing drove Mr. Lloyd into inventing the Lloyd oxy-acetylene method of making seamless steel tubing. By this method the very thinnest gauge steel tubing is possible, the thinner the tubing the cheaper the price, due to the fact that under the Lloyd method the real cost of the tubing is the material, while in all other cases the high cost is due to the numerous operations in which labor plays an important part along with material.

George W. Rowell, Jr.

STEEL WIRE AND NAIL MAKING. The importance of the steel wire and nail industry in the United States may be measured by the fact that in 1902 there was produced a total of 1,574,293 tons of wire rods of which nearly 500,000 tons were made into wire nails. In 1909 the production of wire rods was 2,514,504 tons, valued at $67,440.000. The 1918 output is estimated as 3,000,000 tons, of the value of $100,000,000. About one-fourth of this goes into nails. Time was when both wire and nails were manufactured entirely from wrought iron, and to secure the toughness and high tensile strength required, great care had to be used in the preparation of the iron, the cost of the product being proportionately high. It was only a question of time before steel, because of its less cost and its high strength, became the standard material in this as in other branches of the iron and steel industry; and today practically the whole of the wire and wire nails used are made from either Bessemer or open-hearth steel, the latter being specified where wire of the special grades with higher physical properties is required.

Physical Properties of Steel Wire.— As showing the great increase in strength of steel over iron wire, it may be mentioned that while good black iron wire will show an ultimate tensile strength of about 25 tons to the square inch, and bright hard-drawn wire a strength of 35 tons to the square inch, Bessemer steel wire will stand a strain of 40 tons and open-hearth steel wire 60 tons to the inch. Of the «special» grades of wire a high-carbon open-hearth steel will stand about 80 tons, crucible cast-steel wire about 100 tons, and the best cast steel, or as it is sometimes called, «plow» steel wire, 120 tons to the square inch; while certain qualities of cast-steel wire, made under specifications calling for a particular composition and requiring very elaborate working, have been produced, showing an ultimate breaking strength of from 150 to 170 tons to the square inch. The process of wire-drawing serves greatly to improve the physical qualities, and the smaller the size to which the wire is drawn down the greater is the ultimate breaking strength. The wonderful qualities of piano wire are proverbial, the average strength of English piano wire as given by the manufacturers ranging from 225 pounds for No. 12 music wire gauge, which is 0.029 inch in diameter, to 650 pounds breaking strength for No. 22, which is 0.052 inch in diameter. Reduced to the square-inch unit, the ultimate tensile strength per square inch would range from 300,000 pounds to 340,000 pounds. The composition of this remarkable wire is as follows: Carbon, 0.570; silicon, 0.090; sulphur, 0.011; phosphorus, 0.018; manganese, 0.425. An analysis of another wire of unusual strength known as «plow,» shows 0.828 per cent of carbon, 0.587 per cent of manganese, 0.143 per cent of silicon, 0.009 per cent of sulphur, 0.030 per cent of copper and no phosphorus. The tests of this wire ran from 200,000 pounds per square inch for wire 0.191 inch in diameter to 350,000 pounds for wire 0.093 inch in diameter. Of course, with such high tensile strength the elongation or stretch was very small, ranging from 0.75 to 1.1 per cent only.

Billet Yard.—The bulk of the wire and wire nails of commerce are manufactured from Bessemer billets. Open-hearth billets are worked up into rods for the manufacture of chain, for special grades of wire and for various finished products in which high tensile strength is called for. In each rod mill billet continuous-heating furnaces are continually at work. The billets, which are 4 × 4 inches in section and 36 inches in length, are fed transversely into the furnace, side by side. They are pushed through the furnace door by a hydraulic charging machine, and by the time they have been heated to the proper temperature for rolling, they are pushed, one after the other, out through the rear door of the furnace and fall upon a conveyor, by which they are carried down into the rod mill.

Roughing Mill.—The roughing mill consists usually of eight pairs of rolls, in which the billet is reduced from a 4-inch x 4-inch section to a three-fourths inch square section, and it is in this mill that the steel receives the first instalment of that thorough mechanical working which contributes so greatly to its ultimate tensile strength. Each pair of rolls is placed at an increasing distance from the one that precedes it, in order to allow for the increase in length due to the decrease of section of the billet. It has been found, moreover, that by changing the shapes of the grooves in the successive pairs of rolls, making them alternately square and oval, oval and round, etc., there is not only an economy of power secured, but a more thorough working or manipulation of the metal is obtained, and its qualities are proportionately improved. In the eighth set of rolls, or «pass,» as it is technically known, the grooves are three-quarters of an inch square. From these, the last pair of roughing rolls, the rods are carried to the finishing mill.

Finishing Mill.— In this mill the wire rods are given commonly 10 more passes and brought down to the required dimensions. The finishing mill generally lies at right angles to the roughing mill; and instead of the rods passing through pair after pair of rolls in a continuous straight line, they pass through the successive rolls in alternating directions, describing half-circles between each pair. In order to guide the rods into the proper rolls, workmen stand between each pair, and as the rod issues from the rolls it is seized with a pair of tongs, bent around through a half-circle and fed to the next «pass.» Consequently, when a rod mill is in full blast, it presents one of the most interesting sights. Owing to the rapid decrease in section and increase in length, as the rod passes through the successive rolls, it is necessary that the speed of the successive rolls be increased; and by the time the rod issues from the tenth roll of the finishing mill, it is traveling at a speed of 1,350 feet per minute, or about 15 miles an hour. As the whole of the rolling down from the 4-inch x 4-inch billet to the finished rod, which will be, say, 13-64 of an inch in diameter, is done at one heat, it can be understood that the scene is extremely picturesque. In order to protect the men who stand between the pairs of rolls and direct the course of the rods, a series of curved semi-circular guards or shields are fastened upon the iron floor of the mill. The amount of working to which the steel is subjected, and the great horse power that is required to perform this duty, may be judged from the fact that the billet, which at the first pass through the mills was 4 inches x 4 inches in section and only 3 feet long, as it issues from the last pair of rolls is a scant quarter of an inch in diameter and measures no less than 1,189 feet, or not far from a quarter of a mile in length. As the rods leave the last pair of rolls the ends are caught up and attached to the drums of a set of reels, on which they are wound up into a convenient coil for further handling. As soon as the coil is completed, it is dropped from the reel onto the floor of a conveyor, by which it is carried to the wire mill.

Wire-Drawing.— Up to this point the product is known by the technical name of «rods,» and it is only after it has been drawn down in the dies that it is known commercially as «wire.» Wire-drawing has the advantage of permitting the production of a much smaller wire than could be produced under the rolls, while the very process of drawing down the wire greatly enhances its physical qualities, increasing the tensile strength to a truly remarkable degree. The wire-drawing machine consists of a stout bench, on which is mounted a strong cast-iron drum, on which the wire is wound as it is drawn through the plate. The draw-plates, or die-plates, as they are called, are stout blocks of cast steel which are perforated with conical holes, carefully gauged to the exact desired size of the wire. The holes have a slight taper, the wire, of course, entering at the larger end of the hole. The coil of wire is placed on a spool located on the floor of the shop near the bench, and the end of the wire having been swagged down is passed through the die-plate and attached to the drum, which then proceeds to wind up the wire until the whole coil has been drawn down. As the wire-drawing is done cold, it can be well understood that with several score of these machines running at the same time it requires very powerful motive power to drive the mill. An increasing quantity of wire is now drawn to special shapes other than round — some square, or flat, some of D-section, or with a groove, these being adapted to various mechanical uses. After it has been drawn down, it is necessary to remove the strains in the wire, and it is accordingly taken to the annealing room, where it is loaded into large annealing pots. After the pot is filled, it is carefully sealed with sand to exclude the air, and the wire is exposed to a steady heat for a period of from eight to nine hours. Of the total product, part is now ready for the open market without any further treatment, a small portion of it is sent to the galvanizing room to be galvanized and a large proportion of it goes to the nail mill to be made up into wire nails or barbed wire.

Nail Mill.— In the nail mill each separate machine is capable of turning out from 150 to 500 finished nails per minute. In front of each machine is a reel, upon which the coil of wire is placed. One end of the wire is led into the machine, and as the power is thrown on, one sees the wire disappear through a small hole in the massive vertical casting; while to the accompaniment of a rapid succession of blows, a stream of the finished wire nails begins to pour out of the side of the machine into small iron boxes placed to receive them. The wire first passes between two pairs of horizontal, grooved wheels, which are pressed firmly together to give the required tension to the wire as it is drawn into the machine after each finished nail has been formed and cut off. The nail is pointed by the action of a pair of pliers with V-shaped cutting edges and the head is formed up by the action of a very powerful cam-operated member, which strikes a hammer-like blow. As each nail is finished, the wire is gripped and enough of it drawn forward to form another nail. The 3-D fine nails are turned out at the rate of 500 per minute, and the large

60-D nails at the rate of 150 per minute. The boxes of finished nails are covered up and taken to big, revolving iron cylinders, known as rumblers, where they are rolled over and over, the nails being thrown against each other and against the sides of the cylinders and receiving that high polish which characterizes the finished product. The time during which they are treated in the rumblers varies according to the size and quality of the wire. A certain amount of sawdust is also used during this process in order to clean the nails thoroughly of grease and dirt. The nails are then loaded into 100-pound kegs, stenciled with the size and weight of the nails and the makers' name and taken to the warehouse.

Barbed Wire.— In a barbed wire shop coils of wire, carried on reels, are placed contiguous to the «barb» machines. The wire from two spools serves to form the strands, and the wire from the other two spools is used for the «barb.» The two-strand wires, which are heavier than the others, are led between a pair of friction wheels, and drawn to proper tension. They are then met by the two other strands, which are led in transversely, one on either side. At stated intervals of a few inches, according to the spacing of the barbs, a pair of revolving fingers catch the two barb wires and give them a twist around one of the strand wires and at the conclusion of the twist two pairs of shears cut the ends of the barb diagonally, giving them the desired sharp points. The two wires next pass downwardly around an idler, and then horizontally into a combined winding and twisting frame. The frame itself revolves on a horizontal axis parallel with the machine, and serves by its revolution to twist the two strands. On a shaft arranged transversely within this frame is carried the barbed-wire spool, on which the finished product is wound ready for the market. When it is once started the operation is continuous and extremely rapid.

STEEL-WOOL, a material largely used as a substitute for sand paper or emery paper, for polishing metal or wood surfaces. It is simply a collection of very fine drawn steel wire waste or minute shavings made in turning steel, the result being a mass that looks and feels like wool, but on close examination what appear to be hairs are discovered to be very fine steel curlings.

STEEL-YARD. See Balance.

STEELE, Daniel, American Methodist Episcopal clergyman, and university president: b. Windham, N. Y., 5 Oct. 1824; d. 2 Sept. 1914. He was graduated at Wesleyan University in 1848 and held various pastorates until 1862. He was a professor at Genesee College, Lima, N. Y., in 1862–71, and in 1872, upon the organization of Syracuse University, he was elected its first president. He resigned later in that year, however, to resume work as a pastor at Boston. In 1884–93 he was professor at the Boston University School of Theology, after which he retired. He wrote ‹A Commentary on Joshua› (1873); ‹Milestone Papers› (1878); ‹Commentary on Leviticus and Numbers› (1891); ‹Jesus Exultant› (1899); ‹Half Hours with Saint John's Epistles› (1901), etc.

STEELE, stēl, **Flora Annie Webster,** English novelist: b. Harrow, Middlesex, 2 April 1847. She lived in India until 1889, was provincial inspector of government and aided schools in Punjab, and for several years a member of the educational committee. She was married to a Bengal civilian in 1867. Her publications include ‹Wide-a-Wake Stories› (1884); ‹From the Five Rivers› (1893); ‹Tales from the Punjab› (1894); ‹On the Face of the Waters› (1895), a work of much power; ‹The Host of the Lord› (1900); ‹Voices in the Night› (1900), etc.

STEELE, Joel Dorman, American textbook author: b. Lima, N. Y., 14 May 1836; d. Elmira, N. Y., 25 May 1886. He was graduated at Genesee College in 1858, and was later engaged in teaching. He became a captain in the 81st New York Volunteers in the first year of the Civil War, saw service in the Peninsular Campaign and was severely wounded at Seven Pines. He was principal of the Newark, N. Y., High School in 1862–66; and of the Elmira Academy in 1866–72. He was thereafter engaged in preparing textbooks, in which occupation he was highly successful. He became a trustee of Syracuse University in 1872, and bequeathed $50,000 to that institution to found a chair of theistic science. His textbooks were planned for periods of 14 weeks' study, and were widely used. He wrote ‹Chemistry› (1867); ‹Astronomy› (1868); ‹Natural Philosophy› (1869); ‹Geology› (1870); ‹Human Physiology› (1873); ‹Zoology› (1875); ‹Barnes' Popular History of the United States› (1875). With his wife, Esther Baker Steele, he was author of a series of short histories: ‹United States› (1872); ‹France› (1874); ‹Ancient Peoples› (1883); ‹Mediæval and Modern Peoples› (1883); ‹General History› (1883); ‹Greece› (1883); ‹Rome› (1884).

STEELE, Sir **John,** Scottish sculptor: b. Aberdeen, 18 Sept. 1804; d. Edinburgh, 15 Sept. 1891. He received his art education in the Royal Academy, Edinburgh, and also in Rome. In the competition for a statue of Sir Walter Scott he was chosen to execute the seated figure for the Scott Monument in Edinburgh, and from the time of its unveiling (1846) his professional success was assured. Among his best known works, also in Edinburgh, are the statues of Wellington (1852), Professor Wilson, Allan Ramsay, Thomas Chalmers, Queen Victoria, and the Scottish memorial to the prince consort, on the completion of which (1876) the artist was knighted.

STEELE, Sir **Richard,** British author: b. Dublin, March 1672; d. Carmarthen, Wales, 1 Sept. 1729. He left Oxford without taking a degree, for some time rode as a private trooper in the dragoon guards, obtained an ensigncy in the foot guards, and wrote as his first comedy, the ‹Funeral,› or ‹Grief à-la-mode,› which was acted in 1701, with considerable success. Through the recommendation of Addison, whom he had known at Charter-house, he was appointed, in the beginning of the reign of Anne, to the post of writer of the London *Gazette*. His comedy of the ‹Tender Husband› (in which Addison had some hand) appeared in 1703, and his ‹Lying Lover› in 1704. In 1709 he began the periodical paper so celebrated under the title of the *Tatler* (q.v.). The majority of the papers in this periodical are by Steele, but a considerable number are wholly or partly by Addison, and one or two by other writers. Early in 1711 the *Tatler* was succeeded by the still more celebrated *Spectator* (q.v.). The *Spectator* terminating, Steele commenced, in March 1713, the *Guardian*, which was followed in October of the same year by a political periodical called the *Englishman*. By this time he had taken to active political life, having been returned to Parliament as member for Stockbridge in August 1713. In March 1714, he was expelled from the House for an alleged libel in the last number of the *Englishman*, and in another paper called the *Crisis*. On the accession of George I he received the appointments of surveyor of the royal stables, and governor of the king's comedians, and was knighted (1715). He again entered the House of Commons as member for Boroughbridge. Always engaged in some scheme or other, few or none of which succeeded, he wasted his regular income in the anticipation of a greater, until absolute distress was the consequence. In 1720 his patent as governor of the royal comedians was revoked. He appealed to the public, in a paper called the *Theatre*, which he had begun to publish at the beginning of 1720, a week or two before the event referred to. He was restored, the following year, to his authority over Drury Lane Theatre, and soon after wrote his comedy of the 'Conscious Lovers,' on a hint from Terence. This piece he dedicated to the king, who rewarded the author with £500. Consult the 'Life' by Aitken (1889) and by Dobson (1886), who also edited 'Selected Works' (1885).

STEELE, Sir Samuel Benfield, Canadian soldier: b. Purbrook, Ontario, 5 Jan. 1849. He was educated at the British American Commercial School and at the Royal Military School, Toronto. He served in the Fenian Raid in 1866; in the Red River Expedition in 1870; joined the Canadian Permanent Artillery in 1871, and the Royal North West Mounted Police in 1873, becoming its superintendent in 1885. He commanded a body of cavalry and scouts in the second Louis Riel Rebellion in 1885; and in 1898 he commanded the Royal North West Mounted Police during the Klondike gold rush. He served in Africa in the Boer War in 1899–1901, attaining rank as colonel; was administrator of the 10th and 13th military districts in Canada in 1907–10; and upon the outbreak of the European War in 1914 he engaged in organizing the troops of Manitoba. In December 1914 he was promoted brigadier-general with rank of major-general, and became inspector-general for western Canada. He organized, commanded and trained the Second Canadian Division in 1915; and in 1915–18 he commanded the Imperial and Canadian troops at Shorncliff. He was knighted in 1918. Author of 'Forty Years in Canada' (1915).

STEELHEAD, a fish. See Salmon.

STEELTON, Canada, town in Algoma District, province of Ontario, 10 miles northwest of Sault Sainte Marie, Mich., on the Algoma Central and Hudson Bay and the Canadian Pacific railways. There are manufacturing industries. Pop. 3,936.

STEELTON, stēl'tŏn, Pa., borough, Dauphin County, on the Susquehanna River, the Pennsylvania Canal, and on the Philadelphia and Reading and the Pennsylvania railroads, three miles east of Harrisburg. An electric line connects the borough with Harrisburg. In 1866 the place was laid out under the name of Baldwin; later it was called Steel-Works P. O., and in 1880 it was incorporated under its present name. The chief industrial establishments of the place are owned by the Pennsylvania Steel Company, which has bridge and construction works, several blast furnaces, and rail and blooming mills. Other manufactories are lumber mills, several flour mills, brick yards and machine shops. The public school was erected by the Steel Company. The national bank has a capital of $75,000. Pop. 18,000.

STEEN, stān, **Jan Havickz,** Dutch painter: b. Leyden, 1626; d. 1679. He studied under Nicolas Knupfer, Van Ostade, and Van Goyen, and married the daughter of the latter. From the conflicting accounts of his career it appears that he was at one time a tavern-keeper, and the tradition is that he led a drunken and dissolute life; but in disproof of this his numerous paintings attest that he must have been a laborious and careful worker. He stands in the foremost rank among Dutch painters alike as regards execution, composition and color, and the action, gestures and expression of his figures, while his composition is always full of spirited suggestiveness and genial humor. In the British National Gallery he is represented by 'The Music Master,' but his chief paintings are to be seen in the galleries of The Hague and Amsterdam. Consult Van Westrheene, 'Jan Steen, Etude sur l'Art' (1856); Bode, W., 'Great Masters of Dutch and Flemish Painting' (New York 1909).

STEENSTRUP, stān'stroop, **Johann Iapetus Smith,** Norwegian zoologist and archæologist: b. Vang, 8 March 1813; d. Copenhagen, 20 June 1897. From 1845 until his retirement from active duties in 1885 he was professor of zoology and director of the zoological museum at Copenhagen. He was a busy investigator and wrote treatises on a wide range of subjects, from parasitic crabs and the change in the position of the eyes in flounders, to peat-bogs and the prehistoric remains known as kitchen-middens. He wrote also 'Yak-Lungta Bracteaterne' (1892).

STEENWYCK, stān'vīk, **Henrik van,** Dutch painter: b. Steenwyck, 1550; d. Frankfort-on-Main, 1603. He excelled in the execution of church interiors and was a master of both linear and aerial perspective. His son, Hendrik, called "the young Steenwyck," was born about 1589, and became the friend of Vandyke, for whom he is said to have painted architectural backgrounds. He died in London, in what year is unknown, but it must have been subsequent to 1647.

STEEPLE, *in architecture,* any tower-like structure attached to a church, whether a tower proper or spire or a combination of tower and spire or tower and lantern. See Spire.

STEEPLE-BUSH. See Hardhack.

STEEPLECHASING, horse racing over a rough course, so called from the fact that the riding involves steep hill climbing or that the riders had a distant church steeple as a goal which they reached regardless of the country over which they might be obliged to travel. Steeplechase racing is most exciting, as the obstacles over which the horses are obliged to jump involves considerable danger. The Great National Steeplechase of Liverpool is a big English racing event. It was established in 1839. The Meadowbrook Club in the United States is the pioneer of steeplechasing.

STEERAGE, in passenger steamships, a section on or below the main deck that has common appointments and is assigned to the cheapest class of passengers. Since it is mainly occupied by immigrants and poor people, the term has acquired a literary sense equivalent to «common people.» In a war-vessel the quarters of the junior officers, clerks, etc., fitted with lockers, mess tables, etc. The character of a vessel's response to her helm is also termed steerage. Steerage-way implies a sufficient degree of motion communicated to a ship for her to become susceptible of the effects of the helm in governing her course.

STEEVENS, stē'vĕnz, **George,** English Shakesperean critic: b. Poplar, London, 10 May 1736; d. Hampstead, 22 Jan. 1800. He was educated at Eton and King's College, Cambridge, but did not take a degree, and in 1766 published 'Twenty of the Plays of Shakespeare' in four volumes. After this he was associated with Dr. Johnson in an edition of Shakespeare published in 1773. He then prepared (1793) a corrected text, with notes of the dramatist's works, in 15 volumes, which long remained the standard edition. He made many enemies by his acrimonious and ill-natured attacks on contemporary editors and others, but his contribution to Shakespearean criticism has permanent value.

STEEVENS, George Warrington, English journalist: b. Seydenham, near London, 10 Dec. 1869; d. Ladysmith, South Africa, 15 Jan. 1900. He was graduated at both Oxford and London universities in 1892, and in 1893 he became a Fellow of Pembroke College, Oxford. In the summer of 1893, however, he abandoned his fellowship, and embarked upon a journalistic career in London. He had already contributed to the *National Observer* and other publications, and now joined the staff of the *Pall Mall Gazette,* also contributing to the *New Review* and to *Blackwood's Magazine.* Upon the establishment of the *Daily Mail* in 1895 he became a member of its staff, and it was as its correspondent on various missions in foreign countries that he established his reputation as a writer gifted with the power of vivid description and with a keen perception of salient points. He covered the McKinley-Bryan Presidential campaign in the United States in 1896; and his first experience as a war correspondent was with the Turkish army in the Græco-Turkish War in Thessaly in 1897. He was with Kitchener's army in Egypt in 1898, and wrote a brilliant account of the campaign. He was in India in the winter of 1898–99; and in 1899 reported the second trial of Captain Dreyfus at Rennes. In September 1899 he went to South Africa as the *Daily Mail's* correspondent. He was with Sir George White at the defense of Natal, and at the siege of Ladysmith, where he died of enteric fever. He wrote 'The Land of the Dollar' (1897); 'With the Conquering Turk' (1899); 'Egypt in 1898' (1899); 'With Kitchener at Khartoum' (1899); 'From Capetown to Ladysmith' (1900).

STEFÁNSSON, stä'fän-sŏn, **Vilhjálmur,** Arctic explorer: b. Arnes, Manitoba, Canada, 3 Nov. 1879. He received his education at the State University of North Dakota and the State University of Iowa. In 1903–04 he studied at the Harvard Divinity School, and in 1904–06 at the Harvard Graduate School. His early years were spent on a farm; in 1893–96 he was a cow-boy; at different times he was employed as school teacher, life insurance agent, organizer of secret society lodges, public lecturer, reporter on the Boston *Evening Transcript,* city editor of the *Plaindealer,* Grand Forks, N. D., and assistant instructor in anthropology at Harvard University. In 1904 he undertook a private expedition to Iceland and in 1905 undertook an archæological expedition to Iceland for Harvard University. In 1906–07 he made an ethnological expedition to the Eskimo of the mouth of the Mackenzie River and northern Alaska for the universities of Harvard and Toronto. He undertook a second Arctic expedition under the auspices of the American Museum of Natural History and the Geological Survey of Canada, accompanied by Dr. Rudolph M. Anderson, zoologist, in 1908–12; made investigations and collections in geography, geology, ethnology, archæology, zoology, botany, etc., reported so-called blond Eskimo found on both sides of Dolphin and Union straits and Coronation Gulf and visited several tribes whose ancestors had never and who themselves had never seen a white man. Stefánsson was commander of the Canadian Arctic expedition which sailed from Victoria, British Columbia, in June 1913, for four years of exploration north of Canada and Alaska. With two companions he crossed Beaufort Sea on moving ice from Martin Point, Alaska, to the northwest corner of Banks Island. With three companions he explored the sea west of Prince Patrick Island to the north of which he discovered a new land in 1915. In September 1915 he left Cape Bathurst with the schooner *Polar Bear,* outfitted for two years' further exploration of land already discovered, and seas to the west and north. He returned in 1918, and in the same year was awarded the Charles P. Daly medal of the American Geographical Society. V. Stefánsson has published 'Arctic Search' (1913); 'My Life with the Eskimo' (1914); and many scientific articles in journals of anthropology, folklore, philology, geography; also popular articles on literature of Iceland in *Poet-Lore* and on the Eskimo and Arctic travel, chiefly in *Harper's Magazine* after 1906.

STEFFANI, stä-fä-'nē, **Agostino, Abbate,** Italian composer: b. Castlefranco, Venice, 1655; d. Frankfort-on-Main, 1730. He received his musical training in Venice and Munich, in which latter city he was appointed director of the Grand-ducal Concerts (1681), and, after the production of his opera 'Servio Tullio' in 1688, chapel master to the court of Hanover. In that capacity he did much to improve the religious music of his day. His Italian operas, which were produced with brilliant stage setting at Herrenhausen Castle, were also translated into German and performed at Hamburg (1690). Fine as are his operas, his chamber music, much of it set to Italian words, is even richer in melody and tonal expression. Later in life he became more and more engrossed in his diplomatic duties, resigned to Handel his office of chapel master (1710), and was appointed councillor by the Grand-duke Palatine, and, by the Pope, prothonotary and bishop of Spizza (*in partibus*). He applied himself henceforth to his civil and religious functions, in pursuance of which he made his last visit to Italy in 1729. His works include 'Psalmodia Vespertina, for Eight Voices' (1674); 'Sonate da Camera a due violine, alto e continuo' (1679); 'Duetti da Camera a soprano e contralto' (1683), etc.

STEFFENS, Joseph Lincoln, American author: b. San Francisco, Cal., 6 April 1866. He was graduated at the University of California in 1889 and later studied at the universities of Berlin, Heidelberg, Leipzig and Paris. He was connected with the New York *Evening Post* in 1892–98; was city editor of the New York *Commercial Advertiser* in 1898–1902; managing editor of *McClure's Magazine* in 1902–06; and editor of the *American Magazine* and of *Everybody's Magazine* in 1906–11. He is well known as a contributor of short fiction and special articles to magazines. Author of 'The Shame of the Cities' (1904); 'The Struggle for Self-Government' (1906); 'The Uplifters' (1909); 'The Least of These' (1910).

STEGOCEPHALIA, one of the primary divisions of the amphibia, sometimes considered as a sub-class, sometimes as an order, especially characterized by the great development of dermal or superficial bones on the dorsal surface of the head. Being totally extinct and consequently known only from their skeletal remains many questions concerning their relationships continue open. Many of the stegocephali were of salamander-like form, with broad, flattened head, simple, weak paired limbs of the typical pentadactyl type and a more or less elongated tail. Some were lizard-like with stronger limbs. Some, like *Ophiderpeton,* lacked limbs and were serpentine in form. Many are known to have passed through branchiate larval stages and some, like the *Branchiosauridæ,* retained the gills throughout life. Many of the large labyrinthodonts had rudimentary tails and must have been somewhat frog-like in aspect. One remarkable form, the *Dissorophus multicinctus* from the Permian formation of Texas, is described by Professor Cope as having borne an armadillo-like carapace on the back. The roofing bones of the head were numerous and covered the temporal fossa as well as the cranium. In some of the larger forms they were much sculptured and excavated for the accommodation of mucous canals. The large eyes were supported by a ring of sclerotic bones, found well developed at the present day only in the eyes of some birds. In the middle of the cranial roof between the two parietal bones was the conspicuous pineal foramen supposed to have lodged a functional median eye. The nostrils were situated near the tip of the snout and the internal nares in the anterior part of the palate. The base of the skull was imperfectly ossified, but there was a well-developed basi-occipital bone with usually two occipital condyles. This deficiency of bone was supplied by the large superficial parasphenoid. The lower jaw was complex and the occurrence of an infradentary bone is especially noteworthy. Teeth of a simple, conical, partly hollow form, or with the walls fluted or, as in the labyrinthodonta (q.v.), complexly folded, existed on the jaws and palate. The notochord generally persisted and the vertebræ consisted of mere bony shells or were better ossified and formed of alternating intercentra and pleurocentra supporting the hæmal and neural arches or were otherwise segmented. There was never more than a single sacral vertebra. Scapula, coracoid, clavicle and interclavicle were always present in the shoulder girdle and traces of a sternum sometimes appear. Likewise an ischium, ilium and occasionally a pubis have been found on each side of the pelvis. Both fore and hind limbs were simple and salamander-like, the carpus and tarsus unossified in the smaller species and presenting all of the primitive elements with two or three centralia in *Archegosaurus* and other larger forms. Ribs were simple and never joined the sternum. Some forms like *Branchiosaurus* were covered with an armor of scales.

The stegocephali were the first vertebrates to leave the water and assume more or less completely terrestrial habits; they were the first whose limbs departed from the fin type and became pentadactyl; their nasal passages show that they breathed air and they probably had lungs; their teeth indicate a flesh diet, probably consisting chiefly of fish. Footprints of stegocephali are found in abundance in rocks representing the muddy shores of the Carboniferous Period and remains of these creatures are found from the Lower Carboniferous through the Permian and in the Triassic in Europe and America. They are especially abundant in the Permian of Texas from which many interesting forms have been taken. Palæontologists differ on the question of their origin, some considering them descendants of the crossopterygians, others of the Dipnoans. Whatever their origin the stegocephali formed the starting point for all terrestrial and air-breathing vertebrates, probably first giving rise to primitive reptiles like the cotylosauria, becoming themselves extinct. Consult Credner, 'Die Urvierfüssler'; 'Naturw. Wochenschrift' (Berlin 1891); Cope, 'American Naturalist' (1884); Woodward, 'Vertebrate Palæontology' (Cambridge 1898); Knipe, H. R., 'Evolution in the Past' (London 1912).

STEGOSAURIA, a group of dinosaurs (q.v.).

STEIN, stin, **Charlotte von,** German writer, friend of Goethe (q.v.): b. Weimar, 25 Dec. 1742; d. there, 6 Jan. 1827. She was married in 1764 to the duke's master of the horse. Her friendship with Goethe was broken suddenly after his return from Italy (1788). Goethe's 'Letters' to her were first published in 1848–51, edited by Schott. Their almost perfect friendship for 10 years is believed to have profoundly assisted Goethe in his work. A final collection was printed by the Goethe Society in 1886. She wrote a tragedy 'Dido' (1867; ed. by Duntzer). Consult the 'Life' by Duntzer (1874).

STEIN, Heinrich Friedrich Karl, German statesman: b. Nassau, 26 Oct. 1757; d. Kappenberg, Westphalia, 29 June 1831. He studied at Göttingen, entered the mining department of the Prussian government, became head of the mines and manufactures (1784) department in Westphalia, visited the mining districts of England in 1786, became president of the provincial chambers of Westphalia in 1796, and a minister of state in 1804. For the severity of his criticisms on the administration he was dismissed (1807), but in a few months he was recalled, with power to introduce his reforms. Accordingly he abolished serfage by edict, made military service obligatory on all classes, and rearranged the financial and administrative affairs. By means of these reforms he laid the basis of Prussia's future greatness, but in less than a year he was proscribed by Napoleon and dismissed from office. He afterward visited Saint Petersburg, and was instrumental in bringing about the coalition which crushed Napoleon. When the military struggle was over he spent his life in retirement. Consult Pertz, 'Das Leben des Ministers Freiherrn von Stein' (1849); Stern, 'Stein und sein Zeitalter' (1855); Seeley, 'Life and Times of Stein' (1878); Meier, 'Die Reform der Verwaltungsorganisation unter Stein und Hardenberg' (1881); and the popular biographies by Neubauer (1894) and Bauer (1895).

STEIN, Sir Mark Aurel, British Orientalist and archæologist: b. Budapest, Hungary, 26 Nov. 1862. He was educated at the universities of Vienna, Tübingen, Oxford and London. He was registrar of the Punjab University and principal of the Oriental College, Lahore, India, in 1888–99, and in 1899 he became principal of the Calcutta Madrash. The Indian government sent him to conduct archæological investigations in Chinese Turkestan in 1900–01, and he was afterward appointed inspector of education in the Punjab. He was engaged in archæological investigations in central Asia and western China in 1906–08, and in 1909 he became connected with the archæological department of India. He received the gold medal of the Royal Geographical Society in 1909. He published a critical edition, with an English translation, of Kalhana's 'Rājataranginī, or Sanskrit Chronicle of the Kings of Kashmir' (2 vols., 1900); and is author of 'The Sand-Buried Cities of Khotan' (1903); 'Ancient Khotan' (2 vols., 1907); 'Ruins of Desert Cathay' (2 vols., 1912), etc.

STEINER, stī'nėr, **Bernard Christian,** American educator: b. Guilford, Conn., 13 Aug. 1867; prepared for college at the Frederick (Md.) Academy; was graduated at Yale A.B. 1888, A.M. 1890; was a Fellow in history at Johns Hopkins, 1890–91 and Ph.D. 1891; instructor in history at Williams College, 1891–92; instructor of history at Johns Hopkins, 1893, and associate there from 1894 to 1911. He was graduated at University of Maryland with degree of LL.B. in 1894; was dean and professor of constitutional law, Baltimore University, 1897–1900, and was dean and professor of public law in the Baltimore Law School from 1900 to 1904. Since 1892 he has been librarian of the Enoch Pratt Free Library of Baltimore City. His publications include 'Education in Connecticut' (1893); 'Education in Maryland' (1894); 'Citizenship and Suffrage in Maryland' (1895); 'Institutions and Civil Government of Maryland' (1899); 'Life of James McHenry' (1907); 'Life of Reverdy Johnson' (1914), etc.

STEINHAUER, Henry Bird, Canadian Chippewa Indian clergyman and missionary: b. Ramak Indian Settlement, Lake Simcoe, Ontario, 1804; d. Whitefish Lake, Ontario, 29 Dec. 1885. He was adopted and educated by a German family, and about 1840 he accompanied a Methodist missionary, Rev. James Evans, to the Canadian Northwest. He was at Norway House with Evans for about 15 years, acting as Cree interpreter and assisting the missionary in his task of forming symbolic characters for the Cree language. He was afterward ordained in the Methodist Church and established a mission at Whitefish Lake, where he labored until his death. He translated nearly all of the Bible into the Cree language.

STEINHEIL, stīn'hīl, **Karl August,** German physicist and astronomer: b. Rappoltsweiler, Alsace, 12 Oct. 1801; d. Munich, 12 Sept. 1870. After completing a course in law at the University of Erlangen, and courses in astronomy at Göttingen and Königsberg, he was appointed to the chair of physics and mathematics in the University of Munich. He later entered the service of the Austrian government, becoming especially noted for his development and perfection of the telegraph system, a service which he also rendered to the Swiss government a few years later. In 1836 he built the first printing telegraph, invented an electromagnetic telegraph, the electrical clock, a special pyroscope, and brought out the first daguerreotype picture in Germany. He also invented several optical instruments, and in 1854 began the manufacture of optical, astronomical and photographic materials, and it was in his factory that the telescopes for the observatories of Upsala, Mannheim, Leipzig, etc., were made. Steinheilite or iolite, a transparent mineral, was named after him.

STEINHEIL, Louis Charles Auguste, Alsatian painter: b. Strassburg, 26 June 1814; d. Paris, 17 May 1885. He studied with Decaisne and painted in nearly every medium, but gave especial attention to glass painting and church decoration. In 1876 he was commissioned to execute frescoes in the cathedral of Strassburg. Among his works are 'Saint Philomela' (1841); 'Mother' (1847), Nantes Museum.

STEINHEIL, Marguerite, French woman, central figure in a mysterious *cause célèbre:* b. Beaucourt, 16 April 1869. She came of a wealthy family named Japy and was married to Adolphe Steinheil, an artist. They lived in Paris, where Mme. Steinheil became prominent in a distinguished circle, including many of the most famous Parisian lights in politics, art and literature. She was on terms of intimacy with President Faure, and gossip connected here with his sudden death, but no proof was ever produced. On the night of 30–31 May 1908 Mme. Steinheil's husband and her mother, Mme. Japy, were murdered and robbed and Mme. Steinheil herself was found bound and gagged upon a bed. She was later accused of committing the crime, but was acquitted after a sensational trial. There were rumors of political complications, enhanced by a mysterious pearl necklace supposed to have been given her by President Faure. How much or little of truth was in the rumors and accusations rife at the time of the trial has never become known, and no light has ever been thrown upon the crime of which she was accused. After her acquittal she lived in England in retirement. Author of 'My Memoirs' (New York 1912).

STEINITZ, William, German-American chess player: b. Prague, Bohemia, 14 May 1836; d. New York, 12 Aug. 1900. He was educated at Prague and Vienna and early became famous as a chess player, taking prizes at Vienna in 1859, 1860 and 1861. In 1862 he won sixth prize in an international match at London and in 1866 took the first prize in the tournament of the British Chess Association. In the same year he defeated Anderssen in a set match for the world's championship, which he held for 28 years. He later won championship matches from Zukertort, Tchigorin and others. At the Vienna international tournament of 1873 he beat the world's record by winning 16 straight games. That year he settled in London, but in 1882 removed to the United States. During 1885–91 he edited the *International Chess Magazine*. In 1894 he lost his first great match and the championship to Emmanuel Lasker (q.v.). A return match in 1897 was also lost, after which date he ceased playing serious chess. He more than any other player originated the modern school of winning by accumulating minute advantages instead of by grand strategy and combination. He published 'The Modern Chess Instructor' (1889).

STEINMETZ, stīn'mĕts, **Charles Proteus,** American electrician: b. Breslau, Germany, 9 April 1865. He was educated at Breslau, Zürich and Berlin, specializing in mathematics, electrical engineering and chemistry. In 1902 Mr. Steinmetz received the degree of A.M. from Harvard University and in 1903 the degree of Ph.D. from Union University. Since 1893 he has served as consulting engineer of the General Electric Company and since 1902 has in addition held the chair of electrophysics at Union University. Mr. Steinmetz is also Socialist president of the City Council and president of the Board of Education of Schenectady. He is one of the greatest scholars and scientists in the electrical field to-day and his researches have done much to further the progress of applied industrial chemistry. His works include 'Theory and Calculation of Alternating-Current Phenomena' (1897; 5th ed., 1916); 'Theoretical Elements of Electrical Engineering' (4th ed., 1915); 'Theory and Calculation of Transient Electric Phenomena and Oscillations' (1909; 2d ed., 1911); 'General Lectures on Electrical Engineering' (5th ed., 1917); 'Radiation, Light and Illumination' (1909; 2d ed., 1911); 'Engineering Mathematics' (1910; 3d ed., 1917); 'Electric Discharges, Waves and Impulses' (1911); 'America and the New Epoch' (1916); 'Theory and Calculation of Electric Circuits' (1917); 'Theory and Calculation of Electrical Apparatus' (1917), also sundry mathematical papers on theoretical, experimental investigations in electric engineering.

STEINMETZ, Karl Friedrich, Prussian military officer: b. Eisenach, 27 Dec. 1796; d. Landeck, 4 Aug. 1877. He entered the army in 1812 and fought during the Napoleonic campaigns of 1813–15. In 1848 he commanded a regiment of the Royal Guards at Berlin and gained distinction in his encounters with the populace. The same year he fought in the Danish campaigns. In the Austrian War of 1866 he commanded the fifth army corps and defeated the Austrians in three successive engagements at Nachod, Skalitz and Schweinschaeld, 27–29 June. At the outbreak of the Franco-Prussian War he was appointed, in July 1870, to command of the right wing operating in the neighborhood of Metz against Bazaine, and fought at Spichern, Colombey-Nouilly and Gravelotte. At this time friction arose with other officers and he asked to be relieved of his command, which was granted in September 1870, and he was appointed governor-general of Posen and Silesia. The following year he was made field-marshal.

STEINTHAL, stīn'täl, **Heymann,** German philosopher and philologist: b. Gröbzig, Anhalt, 16 May 1825; d. 1899. He was distinguished as a follower of the Herbartian ethical school, maintaining that the psychology of society combined with comparative philology yielded the best results toward the solution of human problems. His philosophy was allied with that of Moritz Lazarus who was co-editor with him of *Zeitschrift für Völkerpsychologie und Sprachwissenschaft* from 1859 to 1890. In philology he followed the methods of Wilhelm von Humboldt whose work he elucidated in several books in 1848, 1864, 1867 and an edition in 1884. He studied and was graduated at the University of Berlin in 1850; from 1852–55 studied Chinese language and literature in Paris; in 1863 became extraordinary professor of philology in Berlin; and after 1872 lecturer at the school of Judaism there on the history and philosophy of religion. His chief works are 'Der Ursprung der Sprache im Zusammenhang mit den letzten Fragen alles Wissens' (1851; 4th ed. 1888); 'Klassification der Sprachen' (1850); 'Charakteristik der hauptsächlichen Typen des Sprachbaues' (1860); 'Die Entwickelung der Schrift' (1852); 'Grammatik, Logik, Psychologie, ihre Prinzipien, etc.' (1885); 'Geschichte der Sprachwissenschaft bei den Griechen und Römern' (1863; 2d ed., 1889–91); 'Die Mande-Negersprachen, psychologisch und phonetisch betrachtet' (1867); 'Abriss der Sprachwissenschaft' (2d ed., 1881); 'Allgemeine Ethik' (1880); 'Zu Bibel und Religionphilosophie' (1890–95); 'Ueber Juden und Judentum,' ed. by Karpeles, posthumous essays, appeared (1906). Consult Achelis, 'Heymann Steinthal' (Hamburg 1898); and 'Wie Steinthal und Lazarus Brüder werden' a memorial essay by his widow in 'Jahrbuch für jüdische Geschichte und Literatur' (1900).

STEINWAY, stīn'wā (originally **STEINWEG), Henry Engelhard,** American piano manufacturer: b. Wolfshagen, Germany, 15 Feb. 1797; d. New York, 1871. He learned organ-building and piano-making and established a business at Seesen, near the Harz Mountains, but emigrated to the United States in 1849, and with his three sons was employed in various piano factories in New York. In 1853 he founded the firm of Steinway & Sons, and in 1855 exhibited a square piano in which the American iron frame was combined with an overstrung scale, the first example of the Steinway system. About 1866 the Steinways began to make upright pianos; their instruments exhibited at the Universal Exhibition of 1867 became models for Continental manufacturers, while later improvements have enabled the firm to take rank with the famous older makers of Europe.

STEJNEGER, Leonhard, American naturalist: b. Bergen, Norway, 30 Oct. 1851. He was graduated at Frederick's University, Christiania, in 1875, and came to the United States in 1881. He went on a natural history expedition to Bering Island and Kamchatka for the United States National Museum in 1882–83, and was appointed assistant curator of that institution at Washington in 1884; he became curator of reptiles there in 1889 and head curator of biology in 1911. Author of 'Poisonous Snakes of North America' (1893); 'Report of the Rookeries of the Commander Islands' (1897); 'The Asiatic Fur Seal Islands and the Fur Seal Industry' (1898); 'The Herpetology of Porto Rico' (1904); 'The Herpetology of Japan' (1907); 'The Origin of the So-Called Atlantic Animals and Plants of Western Norway' (1907), etc.

STELLA MIRA. See MIRA.

STELLARTON, Canada, town in Pictou County, Nova Scotia, on the East River, 75 miles northwest of Halifax, on the Intercolonial Railway. It is situated in a coal-mining region and has manufacturing interests. Pop. 3,910.

STELLHORN, Frederick William, American Lutheran theologian: b. Hanover, Germany, 2 Oct. 1841. He was graduated at Concordia College, Fort Wayne, Ind., in 1862, was ordained to the Lutheran ministry in 1865 and held two pastorates, 1865–69. He was a professor at Northwestern University, Watertown, Wis., 1869–74, at Concordia College, 1874–81, and has been professor of theology at Capital University, Columbus, O., since 1881, and dean of the theological seminary of the same institution since 1903. He has published 'Kurzgefasstes Wörterbuch zum Griechischen Neuen Testament' (2d ed., 1905); 'A Brief Commentary on the Four Gospels' (1891); 'Annotations to the Acts of the Apostles' (1896); 'The Error of Modern Missouri' (1897); 'Die Pastoralbriefe Pauli übersetzt und erklärt' (2 vols., 1899); 'Paul's Epistle to the Romans Briefly Explained' (1899); 'Schriftbeweis des Lutherischen Katechismus' (1912). With a brief intermission he was editor of *Lutherische Kirchenzeitung* 1881–98, and has been editor of *Theologische Zeitblätter* since 1882.

STELLITE, name applied to a series of alloys consisting essentially of cobalt and chromium. The alloy consisting of cobalt and chromium only is made by melting the two metals together and casting the resulting mixture into bars. If the chromium does not exceed 25 or 30 per cent, these bars may be forged into rods or rolled into sheets. During the casting and rolling process the alloy becomes covered with a thin film of oxide of a dark blue-black color. When this is ground off, however, and the rod or plate is polished, it shows a beautiful lustre which is not dimmed by exposure to any kind of metal conditions. It remains perfectly bright in moist air, and even in the atmosphere of a chemical laboratory. In fact it retains its lustre under all circumstances and is only equaled in this respect by gold and the metals of the platinum group. It may be readily forged into spoons, knives, forks, etc., and these articles are so hard that they can scarcely be scratched by the file. The alloy is stiffer than steel. In fact it is the most rigid alloy in use and, while its elastic limit is not very high, it is sufficient for practical purposes in almost any form into which it may be made. When a certain amount of tungsten or molybdenum is added to the alloy, the hardness is greatly increased, and some of the alloys thus formed are harder than any steel ever produced. These latter are termed tool metal alloys, and when cast into bars need only to be ground to a cutting edge and placed in the tool holder of the lathe to render them immediately available. Results obtained with these tools in the machine-shop are very remarkable. Red hot shavings may be cut from steel bars without injury to the edge of the tool, and on certain kinds of work a machinist is able to turn out from 25 to 100 per cent more work in a day than with the best high-speed steel tools. The name stellite is derived from the Latin word *Stella,* meaning a star, because when once polished it always retains its lustre or brightness. Stellite alloys have been manufactured into pocket and table cutlery, spoons, forks, mirrors, razors, knife edges for balances, surgical tools, dental instruments and machine tools. Pocket knife blades made of this metal retain their lustre under all circumstances, and may be used for cutting apples, oranges, lemons and various other fruits without marring their lustre in the slightest degree.

STELVIO, stĕl'vē-ō, Austria, a lofty Alpine pass (9,055 feet), between the Tyrol and Lombardy, forming part of the great military road from Milan to Innsbruck, completed by the Austrian government in 1824, at a cost of $1,500,000. It is 33 miles long, and its bridges and causeways, and terraces cut in the rock are especially noteworthy. The pass is remarkable for its views and the grandeur of its scenery. It can only be utilized in the summer season.

STELZLE, Charles, American Presbyterial clergyman and sociologist: b. New York, 4 June 1869. He was for some years a machinist, studied at the Moody Bible Institute in 1894–95, and in 1895 became pastor of Hope Chapel, Minneapolis, Minn. He was ordained in 1900, and held various pastorates until 1903, when he became superintendent of the Presbyterian Department of Church and Labor, a division of the Home Mission Board. He was organizer and in 1910–12 was director of the Labor Temple in New York; is director of the department of Christian sociology in the Bible Teachers' Training School, New York; investigated the economic aspect of the liquor problem in the United States and Europe in 1914–15; and with a staff of investigators made social surveys of 200 American cities. Author of 'The Workingman and Social Problems' (1903); 'Messages to Workingmen' (1906); 'Principles of Successful Church Advertising' (1909); 'The Church and Labor' (1910); 'The Call of the New Day to the Old Church' (1915); 'Why Prohibition' (1918), etc.

STEM, the main axis of a plant. Stems usually bear foliar organs, such as leaves, but in the carrion-flower (*Stapelia*) and in some other plants no leaves are produced; and in cacti the leaves are rarely observed because they are early deciduous. Though there are stem-like organs among the algæ and fungi (*Thallophytes*) and liverworts and mosses (*Bryophytes*), true stems are found only among the club-mosses, horse-tails and ferns (*Pteridophytes*) and the flowering plants (*Spermatophytes*). In the last-named group the stems are produced by the development of the embryonic plumule, and reach their maximum size in the California redwood which becomes more than 350 feet tall and may exceed 20 feet in diameter.

Stems are very diverse in general habit; they may be erect and unbranched as in most palms; erect and branched as in pine and many other trees; scrambling as in blackberries and raspberries; twining as in morning-glory and hop; climbing as in grape and Boston ivy; creeping as in dewberry and periwinkle; and with many modifications of these general types. They are also definable according to duration as annual and perennial; and according to structure as herbaceous and woody. These are also modified in nature.

Botanists favor a classification which deals with the character of foliar organs borne, thus: (1) leaf-bearing stems, generally most evident since they bear leaves, and consequently aerial and frequently branched; (2) flower-bearing stems; and (3) scale-bearing stems, which bear rather small, more or less leaf-like but not green organs, and may be situated above or below the surface of the soil. The last group runs into many modifications, such as rhizomes, tubers and bulbs below ground, and the buds of trees and shrubs above ground. They are also grouped according to their anatomical structure, as described later.

The functions of stems are usually to lift the leaves and flowers off the ground and expose them to light and air, or to act as storage-organs in which reserve food is placed until needed. While the epidermis remains green, aerial stems can, and do, perform the functions of leaves in assimilating food, a very important office in such plants as cacti. In function the stems may be sharply contrasted with roots or descending axes; but none of these are constant, there being exceptions. Thus, most stems have chlorophyll (q.v.) which is almost never present in roots, except a few aerial ones; stems usually bear leaves, roots do not; the stem-tip is almost invariably a naked growing point, a root-tip is generally protected by a root-cap; stem-branches are superficial outgrowths (exogenous buds), root-branches develop endogenously from an internal layer; and usually stems and roots take opposite directions with respect to gravitation. In describing aerial stems the positions of leaves (nodes) are distinguished from parts which are leafless (internodes); the buds which appear in the axils of the leaves (axillary) from those which are terminal (apical) or which appear arbitrarily (adventitious), etc. The method of branching is also important in classification, as lateral, false dichotomous, dichotomous, etc.

The internal structure of a stem may be understood by examining twigs of a dicotyledonous tree such as oak. The bark peels off and leaves a white woody cylinder. At the place where bark and wood separate is a more or less mucilaginous layer of cells (cambium) which are readily ruptured. This layer is responsible for growth in girth, since its cells are actively dividing during the growing season, forming bark layers externally and wood layers internally. It is also from this layer that the healing of wounds in the stem is conducted. The formation of the «callus» in cuttings and the union of grafts is also a function of this layer; hence its importance from the forester's and horticulturist's standpoint. When a ring of bark, which is usually found in three layers (outer, middle and inner), is removed, but the wood is uninjured, the leaves will not wither; hence the conclusion that the water ascends through the wood. If the ring be through the young wood the leaves will wither; hence the deduction that the ascent of water is through the young wood. This conclusion is corroborated by the fact that trees will flourish after the heart-wood has decayed. The descent of food to the roots and to other places where it is needed for growth or for storage is through the layers just outside the cambium (the inner bark). By means of the microscope and thin sections of stems a great variety of structures are revealed. Commencing with the growing-point there is found an external epidermis and an almost homogeneous internal structure of «fundamental tissue.» This latter becomes more and more differentiated in parts more remote from the tip. Firm strands (fibro-vascular bundles) are usually first observed arranged radially in dicotyledonous plants. They consist of an internal woody part (xylem) and an external bast part (phloem) and between each pair a persistent layer of cambium. Each bundle terminates in a leaf above, becomes connected with others lower down and terminates below in the little rootlets. In the internal structure of the stems of dicotyledonous trees they constitute the wood. Between them are plate-like structures extending, in cross section, like the spokes of a wheel from various points at, near or remote from the centre to or toward the circumference. The fundamental tissue continues undifferentiated in the cambium, slightly modified in the pith, if there be any pith, and in the medullary rays. In monosotyledonous plants the fibro-vascular bundles are scattered in the fundamental tissue, pursue a curved course (inward and outward) and are collateral. The cambium being consumed at an early period of growth accounts for the usually uniform or very slightly tapering stems of plants belonging to this group — bamboos, grasses, etc.— and also for the non-separation of the bark from the generally thin layer of wood which surrounds a mass of pith or a hollow space. The development of growth in these plants is not marked by annual rings as in the dicotyledons.

From an economic standpoint, stems are of wide importance. Various underground stems are used for food, for example, potato, sweet potato, Jerusalem artichoke, onion, asparagus, kohl-rabi, etc. Others are used as condiments such as ginger, licorice, cinnamon, sassafras, etc. Many furnish valuable fibres such as hemp, flax, jute, ramie, etc. Others are employed in tanning, as the barks of oak, chestnut and hemlock. The pith of many, such as sago, are used for food. The juices of others furnish rubber, palm wine, pulque, arrack and various oils. But the most important commercial uses made of stems are probably as timber and lumber, for which the dicotyledonous trees are most widely employed, as will be sufficiently clear from the above discussion. Consult any treatise on botany, as Lang's English edition of 'A Textbook of Botany,' by Strasburger and others (New York 1903).

STENCILING, a mode of decorating or marking with paint or ink, in which the design is formed through the spaces of a pattern. The design or pattern is cut out in a sheet of pasteboard or a thin plate of metal called a stencil, which is applied to whatever is to be marked. The paint or other coloring matter is then laid freely over the stencil by means of a brush, and after the stencil is removed the design remains marked out on those parts of the surface which the coloring matter has reached through the spaces left in the stencil.

STENCILS. A stencil is a thin metal plate or a fibrous or waxed sheet of paper bearing wording or a design formed by cutting through the plate or the chemical coating or waxed surface of a paper sheet, or by embossing the wording upon a thin metal plate. The stencil is used to reproduce quickly characters, designs or wording by rubbing or pressing through the cut portions specially prepared stencil ink or stencil paste, or, in the case of embossed stencils, striking the paper against an inked ribbon covering the raised letters.

Stencils have been in use for several centuries as a means of marking characters upon certain objects. Formerly they were extensively used in making ornamental designs for stamping wood, cloth and paper material or imitating natural pictorial work upon friezes, panels and pottery. The Japanese for hundreds of years have practised the art of stencil making, while the Egyptians and Romans were well versed in it also. It is claimed that the Japanese learned the craft from the Chinese, who, perhaps, can be credited as being one of the first originators. These early stencils were probably not made of metal but of some tough fabric, paper or wood. The metal stencils used so extensively to-day in commercial trades have been developed from the pictorial stencils only within the past 50 years or so. We have definite knowledge that during our Civil War stencil-cutting was practised in America, the stencils being used for marking packing boxes and other shipments, and were cut in metal in about the same manner as stencil cutters cut them now. From that time there has been a huge demand for commercial stencils, as they can be made quickly, economically, and pleasing to the eye. They can be made very small or extremely large, their size being governed only by the dimensions of the metal sheet or the object upon which they are to be imprinted. Any lettering, brand, trademark or other design can be made into stencil form and as such can be reproduced upon any suitable object by placing it against this object and brushing in the letters or design with stencil paste. Being cut from sheet metal, stencils naturally are durable and conveniently handled. The most artistic stencils are those that are laid out by an experienced stencil cutter who is talented in making good designs. This man will sketch out his lettering or design on a piece of sheet brass, copper or zinc, with a pencil, and then cut out the perfected design with special stencil chisels. Thirty or 40 chisels of various curves and sizes and straight chisels from one-thirty-second to one and one-quarter inch wide are used for this purpose, the cutter placing the sheet metal upon a block of lignum vitæ and chipping out the metal in the design, leaving occasional strips of metal, known as ties or stays, so that the design or letters will hold together. Ordinarily, lettering from one-quarter inch to one and one-half inches is usually cut with stencil dies. These stencil dies are steel punches, each bearing a letter of the alphabet or one of the numerals, and, when driven into the sheet metal with a blow of a hammer, will cut out the selected letter or figure. By using a series of these stencil dies, words can be quickly cut into the metal in letters of various heights if desired. The stencil can then be flattened by burnishing it or going over it with a special instrument called a "slapper" and then smoothing it with the mallet on the stencil block. Stencils for commercial use are frequently made by a special type of machine which cuts letters out of oil board or paste board. Such stencils are less durable than metal and necessarily bear only the one style of lettering. Stencils for transferring patterns, as in embroidery, are usually made upon heavy paper, the lines of the design being indicated by small holes pierced through the paper. For wall decorations, either the cut or the perforated stencils are used, the design being cut by hand with sharp knives of various shapes in thin metal, lead foil, tin foil, or prepared paper held against a piece of plate glass.

Another kind of stencil is the waxed paper which is used in mimeograph work and the dermatype stencil, a chemically coated fibrous sheet of great toughness which is converted into a stencil by the impression of type or stylus. With this form of stencil, the fibrous sheet is prepared ready for use of a size about the dimensions of the typewriter paper. It is inserted in the typewriter and a liquid is applied to it with a brush, when it is ready for the type matter. With the ribbon of the typewriter removed or held away from contact with the keys by an attachment usually fitted to typewriters, the pressure of the keys separates the chemical coating on the fibrous sheet. After all the wording required is typed on the sheet, the latter is removed and spread over an inked cylinder of a hand or motor-driven press. Paper of about the usual typewriter size is run between this cylinder and a platen roller, in which operation a small amount of ink is squeezed through all of the places in the fibrous sheet where the typewriter keys have made an impression, which brings out all the letters on the sheet of paper in a very satisfactory manner. For mechanically addressing, a portion of this fibrous sheet enclosed in a frame of paper is placed into a special attachment that can be fitted to a typewriter and the wording can then by typed through the coating on the fibre as explained above. Stencils for addressing purposes are also made by cutting out small letters from stiff paper, by embossing metal plates, or perforating thin metal plates or paper. These perforated, cut or embossed stencils for addressing are made by special machines which stamp dies bearing letters or numerals with cutting edges, or punching surfaces as the case may be, against the stiff paper or thin metal. From these small stencils, the address is imprinted upon the desired place on a paper by means of other machines, either hand or power driven. The usual machine for this purpose holds a tray of these stencils and automatically carries each one over an inked pad where the ink is forced through the letters and printed upon the paper by the pressure of an arm that bears upon the stencil from above. This arm of the machine moves up when the pressure is released, and, if adjusted for the purpose, disposes of the used stencil by pushing it to one side; at the same time it moves forward the next stencil into its proper position on the pad. The addressing from embossed stencil addresses is performed by bringing down a plunger in which there is a rubber section that strikes the paper against an inked ribbon which covers the raised letters of the stencil.

STENDAL, stĕn'däl, Germany, a town in Prussia in the province of Saxony, on the Uchte, 35 miles north of Magdeburg. The cathedral, restored in 1893, contains archæological and natural history collections of the region. It has courts of justice, a Roland pillar, two ancient gateways and a statue of Winckelmann, the art critic. It is an important railway centre. There are textile industries and large railroad shops, starch mills, brick yards, agricultural machine works and other factories. Pop. 27,263.

STENDHAL, stäṅ-däl. See Beyle, Marie-Henri; La Chartreuse de Parme; Le Rouge et le Noir.

STENIA, Turkey, a village on the European side of the Bosporus, eight miles north of Constantinople, of which city it is a suburb. The name is probably an abbreviation of *Sosthenia* («safety»), to which the Argonauts erected a temple in thanksgiving for their safe return from the Golden Fleece expedition. Constantine the Great converted the temple into a Christian church, and had the statue of the winged goddess in it transformed to represent the archangel Michael. In ancient times many sea-fights took place in the bay.

STENNESS, or **STENNIS,** Scotland, a loch in the Orkney Islands, a few miles northeast of Stromness, 14 miles in circumference. It is celebrated for two groups of prehistoric standing stones on its shores similar to those of Stonehenge. The large group, known as the Ring of Brogar, consists of 15 stones in an enclosure 340 feet in diameter. See Stones, Standing.

STENO, stā'nō, **Nicholas,** Danish scientist: b. Copenhagen, 1638; d. Schwerin, Germany, 25 Nov. 1687. He was educated in medicine, made study of the anatomy of the time, wandered about the Continent, finally settled at Florence, was made physician to Grand Duke Ferdinand II, but subsequently turned to a churchly career, was made a Roman Catholic bishop, and went to northern Germany as vicar-apostolic. He was the first to explain the nature of fossil animals, and in writing of the structure of the crust of the earth clearly described the stratification of rocks, and differentiated them as of mechanical, chemical and volcanic origin. Consult the article by Hughes in 'Nature' (1882).

STENOGRAPHY. See Shorthand.

STENOTAPHRUM. See Grasses in the United States.

STENTOR, in Greek history, the name of a herald in the Trojan War, famous for the loudness of his voice, which was said to equal that of 50 other men together; hence, a person having a very loud, strong voice.

STENTOR. See Infusoria.

STEP, Edward, English author: b. London, 11 Nov. 1855. He was editor of *Welcome* (1886–92); *Boys* (1892–94) and *Science Gossip* (1894–95). He has published 'Plant Life' (1880); 'By Seashore, Wood and Moorland' (1891); 'By Vocal Woods and Waters' (1894); 'Romance of Wildflowers' (1899); 'Shell Life' (1901), etc.

STEPHANITE («brittle silver ore»), an orthorhombic metallic mineral, of iron-black color and streak; hardness 2 to 2.5; specific gravity, 6.3; brittle and opaque. It is a silver sulphantimonite, containing a large percentage of silver, and is an important ore of that metal in Austria, Germany, Mexico, Peru, Nevada, Idaho and elsewhere.

STEPHANOTIS, a genus of tropical asclepiadaceous climbing plants. They are twining shrubs, often reaching great heights, with deep-green, coriaceous, opposite leaves. The flowers are large, five parted, waxy and very fragant, in axillary cymes. The corollas are funnel-shaped or salver-shaped, the limb being starlike, with overlapping lobes, and the tube long and cylindrical, but enlarged at the base and often again at the throat. *S. floribunda* is the evergreen greenhouse creeper, from Madagascar, famous for its waxen, fragrant flowers, appearing in spring and summer, and known by its generic name, or occasionally, as wax-flower or Madagascar jasmine.

STEPHANUS (Latin for **Estienne,** ā-tē-ĕn, **Etienne**), **Charles,** French scholar and printer: b. Paris, 1504; d. there, 1564. He abandoned the practice of medicine, in order to undertake the management of the Paris printing house which his brother Robert had abandoned on his retirement to Geneva. He was the author and printer of one of the first encyclopædias and gazetteers, 'Dictionnaire historique et poetique de toutes les nations, hommes, lieux, fleuves,' etc., (1553) and of 'Prædium Rusticum' (1554).

STEPHANUS (Estienne, Etienne), Henry (nephew of the preceding), French scholar and printer: b. Paris, 1528; d. Lyons, March, 1598. He was educated by the most accomplished scholars of his day and in 1551 accompanied his father to Geneva, where he acted as corrector of the press in his father's printing house. In 1554 he set up as an independent publisher and opened a new printing press with the assistance of Huldrich Fugger of Augsburg. He subsequently spent some years in Italy, in England and in the Spanish Netherlands. His monumental work 'Thesaurus Linguæ Græcæ' did not bring him the returns he had counted upon, principally through the rival enterprise of John Scapula, who had been his proofreader, and had treacherously published himself a more handy and cheaper edition of the work. His troubles were increased by the death of his talented wife, Barbe de Wille (1581). Falling in commercial difficulties he became despondent, and was overtaken by sickness during a journey to Lyons; his reason became unsettled and he died in the hospital unattended by a friend. He was one of the most thorough Greek scholars of his time and his publications comprehended every relic of Greek literature then extant, and were distinguished by critical acumen, felicitous conjectural emendation, and exquisite typography. To him the scholars of Europe are indebted for 30 *editiones principes* of classical authors, publications which have remained in many cases the standard text, and the basis for subsequent recensions. He wrote also several important works in the French language, among which may be mentioned 'Traité de la Conformité du Langue Français avec le Grec'; 'L'Introduction au Traité de la Conformité des Merveilles Anciennes avec les Modernes, où Traité préparatif a l'Apologie pour Hérodote' (1566). Consult Feugère, 'Essai sur la vie et les ouvrages de Henri Estienne' (1853).

STEPHANUS (Latinized form of **Estienne, or Etienne), Robert,** brother of Charles Stephanus (q.v.), French scholar and printer: b. Paris, 1503; d. Geneva, 7 Sept. 1559. He early devoted himself to a study of the ancient languages, Hebrew, Greek and Latin, and after the death of his father, Henry Stephanus the printer, he worked in the printing house with his stepfather Simon de Colines, but in 1529 opened an establishment of his own. Ten years later Francis I appointed him "Printer Royal in the Ancient Languages," but the hostility of the divines of the day was roused by his publication of certain works, especially the Bible, and drove him to Geneva (1551), where he joined the Reformed Church. In his house even the servants spoke in Latin. His publications amounted to 382 in all, and included the Bible, Old and New Testaments in the original; the Greek and especially the Latin classics, with prefaces and notes; grammars and school books. Francis I caused to be made for him the famous "royal type" (*characteres regii*). As an author he produced with the collaboration of Jean Thierry de Beauvais his valuable 'Thesaurus Linguæ Latinæ' (1531). Consult Crapelet, 'Robert Estienne, Imprimeur Royal' (1839).

STEPHEN, stē'vĕn, **Saint,** one of the first seven deacons of Apostolic times. He was stoned to death by fanatic Jews, probably in the August of 32 or 33 A.D. In the Acts of the Apostles (chapter six and seven) an account of his character, works and death is given in some detail. He did "great wonders and miracles among the people"; he was "full of faith and power." While dying he prayed for those who were stoning him; and is considered the protomartyr, the earliest Christian witness who died for his faith. In art he is represented in the vestments of a deacon; holding stones in his robe (the dalmatic) or in his hand; or with a stone in one hand, and a palm in the other. He is celebrated in the Greek Church on 27 December; in the Roman Catholic and Anglican Church on the 26th of that month.

STEPHEN, the name of ten popes, as follows:

STEPHEN I, Saint. He succeeded Lucius I in 253 and filled the papal chair till 257. He carried on a controversy with Cyprian of Carthage concerning the validity of the baptism of heretics, deciding in opposition to Cyprian that on being received into orthodoxy they must be rebaptized, which was not then the custom in Africa. He suffered martyrdom, and is honored as a saint, his day being 2 August.

STEPHEN II. He was chosen pope in March 752, but died four days later, before his enthronement and is sometimes erroneously omitted from the list of popes.

STEPHEN III. His pontificate lasted from 752 to 757. He sought the aid of Pepin the Short, against the Lombards who had overrun the exarchate of Ravenna. Pepin on defeating the Lombards gave the exarchate to the Pope, which marks the beginning of the temporal power of the papacy.

STEPHEN IV. He succeeded Saint Paul I in 768 and in a synod held in Rome in 769 sanctioned anew the veneration of relics and saints.

STEPHEN V. He succeeded Saint Leo IV in 816, but his pontificate came to an end the next year. During his pontificate the council of Aix-la-Chapelle was held, by which provisions were made for the foundations of cloistral schools.

STEPHEN VI. He succeeded Hadrian III in 885 and in a controversy with the Emperor Charles the Fat, occasioned by his consecration having occurred before Charles had given his sanction to the election, came off victorious. Guido of Spoleto and Berengarius of Friuli having contended for the throne of Italy Stephen supported the former and crowned him. His pontificate ended in 891 when he was succeeded by Formosus.

STEPHEN VII. In 896 he succeeded Boniface VI, caused the body of Pope Formosus, the predecessor of Boniface VI, to be exhumed and thrown into the Tiber on account of his having belonged to the opposite political party. He also canceled all the ordinances and consecrations of Pope Formosus. The next year he was imprisoned by his opponents and murdered in prison.

STEPHEN VIII. He succeeded Leo VI in the papal chair in 929 and was succeeded by John XI in 931.

STEPHEN IX. He was a relative of Emperor Otto I and his pontificate lasted from 939 to 942.

STEPHEN X. His rule lasted only from 1057 to 1058 but in that time the separation took place between the Roman and Greek churches. His pontificate is also noteworthy on account of the commencement of a series of internal reforms in the church which were probably due to the influence of Hildebrand, afterward Gregory VII.

STEPHEN, king of England: b. Normandy, about 1100; d. 25 Oct. 1154. He was a son of Stephen, Count of Blois, by Adela, a daughter of William the Conqueror. His uncle, Henry I, gave him the earldom of Mortaigne, in Normandy, and large estates in England, in return for which he took the oath for securing the succession to Henry's daughter, the Empress Matilda. Upon the death of Henry, however, he claimed the Crown for himself (December 1135), and was crowned in London. His seat on the throne, by reason of the disaffection of many of the nobility, was very insecure, and in 1138 David of Scotland invaded England to secure the claims of his niece, but in the battle of the Standard was defeated by the northern barons (August 22). In the following year the empress herself landed in England with her half-brother, Robert, Earl of Gloucester, and a civil war ensued, in which Stephen was taken prisoner and Matilda acknowledged queen. Her conduct, however, excited an insurrection against her government; and, being shut up in Winchester Castle, she escaped with difficulty, while the Earl of Gloucester was taken prisoner. Stephen was exchanged for the earl, and the war was renewed. When Matilda retired to Normandy (about 1147) the contest was taken up by her son Henry. Finally the struggle was brought to an end in 1153 by the Treaty of Wallingford, in which it was agreed that Stephen should reign to his death, and that he should be succeeded by Henry.

STEPHEN, the name of several kings of Hungary from the 10th to the 13th century. STEPHEN I, Saint; d. 1038. He succeeded his father as Duke in 997, and was crowned first king of Hungary in 1000. He reformed the manners of his subjects, enacted excellent laws and introduced Christianity into his kingdom. Stephen was canonized and became the patron saint of Hungary. STEPHEN II succeeded his father Koloman in 1114. He invaded Poland and Austria, and marched into Russia, but was unsuccessful everywhere. He abdicated, retired to a monastery, and died in 1131. STEPHEN III; d. 4 March 1173. He was crowned king in 1161, but was almost immediately deposed by the nobles. He regained the Crown, however, in 1165 and reigned till his death. STEPHEN IV; d. Semlin, 1164. He ascended the throne in 1161. He was the uncle of Stephen III by whom he was defeated in 1163, soon after which he died. STEPHEN V; d. 1 Aug. 1272. He reigned two years only, 1270–72, but gained an illustrious name by his victories over Ottocar, king of Bohemia.

STEPHEN, SIR Leslie, English biographer and essayist: b. London, 28 Nov. 1832; d. there, 22 Feb. 1904. He was educated at Eton and Cambridge, and in 1883–84 was Clark lecturer on English literature at Cambridge. He edited *The Cornhill Magazine* 1871–82, and in the last-named year became editor of 'The Dictionary of National Biography,' which position he held for nine years, but continued to contribute to it till the work was completed, writing in all 378 biographies, an amount equal to three entire volumes and practically covering in the list the literary history of the 18th and 19th centuries. He was thoroughly conversant with the work of the theologians, philosophers and economists of those centuries and the outcome of his knowledge is seen in such works as 'History of English Thought in the 18th Century' (1876); 'Freethinking and Plain Speaking' (1873); 'Lives of Johnson' (1878); 'Pope' (1880); and 'Swift' (1882); 'An Agnostic's Apology' (1893); and 'The English Utilitarians' (1900), a work of the utmost importance. Still other works by him are 'The Playground of Europe' (1871), a record of Alpine experiences; 'Hours in a Library' (1874–79); 'Life of Sir James Fitzjames Stephen,' his brother, (1895); 'Social Rights and Duties' (1896); 'Studies of a Biographer' (1898); 'Thomas Hobbes' (1904). He was the warm friend of James Russell Lowell, visiting him more than once in this country, and was an appreciative admirer of the best in American literature and life. At the close of the Civil War he accomplished a great deal toward clearing away prejudice and misunderstandings between America and England in a pamphlet which contained a strong arraignment of the course of the London *Times* during the four years of war. His first wife, the youngest daughter of Thackeray, died in 1875. Stephen's religious attitude was that of the agnostic, but he was not aggressive. His greatest service to his time was in the 'Dictionary of National Biography.' For this work he was an ideal editor, his judgment determining not only the selection of subjects but the choice of writers, and he so carefully held them to their task that the work went regularly forward at the rate of four volumes a year. He was knighted in 1902.

STEPHEN BATHORI, king of Poland: b. Hungary, 1522; d. Grodno, Poland, 12 Dec. 1586. He was the second of the kings elected by the nobles of Poland, having been declared sovereign in 1575 to succeed Henry of Valois, who had become king of France. The royal prerogative, having been curtailed still further than in Henry's time, extended only over a small district adjacent to the king's estate, but Stephen wrested Livonia from Russia. He was the organizer of the first Cossack regiments and established the University of Wilna. See POLAND.

STEPHENS, stē'vĕnz, **Alexander Hamilton,** American statesman: b. near Crawfordsville, Wilkes County, Ga., 11 Feb. 1812; d. Atlanta, Ga., 4 March 1883. He was of Scotch-Irish ancestry; his grandfather, a youthful adherent of the House of Stuart, came to Pennsylvania in 1746, fought under Washington in the French and Indian War and in the Revolution, reaching the rank of captain; late in life he migrated to Georgia. His son, a schoolmaster of humble circumstances, was the father of Alexander and died when the latter was 15 years of age. Alexander was prepared for college by a Presbyterian minister, Rev. Alexander Hamilton Webster, and at the age of 16 he entered Franklin College (now the University of Georgia), a Presbyterian educational society paying his expenses with the understanding that he would become a minister. In 1832 Stephens was graduated with first honors, and having decided not to enter the ministry, he taught school for two years in order to pay for his education. In 1834, after three months' preparation, he passed a brilliant examination and was admitted to the bar. As a lawyer he soon attained marked success and was then drawn into politics. An opponent of the policy of nullification he was one of the leaders in organizing the Whig party in Georgia; he was a member of the State legislature, 1836-42; in 1839 a delegate to the Charleston Commercial Convention; and in 1843 was elected to Congress on a general ticket. In 1838-39 he favored the annexation of Texas by joint resolution, but in 1844 he opposed Tyler's treaty of annexation and in the next year he framed the measure that secured the annexation. Though opposing Polk's policy in the Mexican War he considered the results of that war fortunate for the South. In Congress he fought the principle of the Wilmot Proviso, and was influential in bringing about the Compromise of 1850 which he considered a repeal of the Missouri Compromise. He opposed the strong "Southern Rights" movement that threatened to result in secession in 1850 and drafted the celebrated "Georgia platform" in which the State constitutional convention declared that while not entirely satisfied with the Compromise of 1850, Georgia was anxious to remain in the Union, though further encroachment upon her rights would result in secession. In 1852, Stephens, with other prominent Southern Whigs, signed a declaration that they would not support General Scott, the Whig nominee for President, because he did not approve the Compromise of 1850 as a final settlement of the questions involved. This stand broke up the Whig party in the South. Stephens and his colleague Toombs voted for Daniel Webster after he was dead. Holding the same views as Douglas in regard to the territories Stephens pushed through the House (1854) the Kansas-Nebraska bill. After 1854 he acted with the Democrats in opposing the formation of the American or Know-Nothing party out of the wreck of the Whig organization. Though he disliked Buchanan, Stephens supported his administration until 1859 when foreseeing a prolonged conflict over slavery he retired from Congress. In Congress he was a moderate pro-slavery man, not disposed to make extreme demands for theoretical rights. In 1860 he was on the Douglas electoral ticket and in Georgia he led the opposition to secession both before the people and in the Georgia convention, where, though asserting the right of the State to secede, he declared that conditions did not then justify a resort to that remedy. When his State seceded he acquiesced, was elected to the Confederate Provisional Congress by which he was chosen vice-president of the provisional government, and was sent to arrange a treaty between the Confederacy and Virginia. In 1862 he was elected vice-president under the permanent Constitution of the Confederate States. He was unable to reconcile his theories of government with conditions of war and was often at variance with President Davis on questions of war policy and State rights. In consequence the elements of opposition to the Davis administration gathered around him, but he had little influence during the war. In 1864 Stephens, his half brother, Linton Stephens, Robert Toombs and Joseph E. Brown were leaders of the Georgia Peace party which declared that the Richmond government could make peace if Davis desired. In February 1865 Stephens headed the unsuccessful Confederate Peace Commission which met President Lincoln at Hampton Roads. Before the end of the war Stephens, discouraged, left Richmond and returned to his home in Georgia whence arose the report that he had deserted the Confederacy. He was arrested by the Federals in May 1865 and confined in Fort Warren in Boston Harbor until October when he was paroled. Stephens favored President Johnson's plan of restoration of the Union, saying that since the South had failed to preserve the Constitution out of the Union it should try again to save it within the Union. In 1866 he was elected to the United States Senate, but on account of the controversy over reconstruction, was refused a seat. He then turned his attention to writing a history of the sectional controversy, the first volume of which was published in 1867 and the second in 1870. In 1868 he was elected professor of history and political science in the University of Georgia, but on account of ill health, he was forced to decline. He edited the Atlanta *Sun* in 1871 in opposition to the election of Horace Greeley. Having lost nearly all his savings in this venture he undertook the instruction of a private law class. In 1871 he was an unsuccessful candidate for the United States Senate, but in 1874 he was elected to the lower house of Congress where he remained until 1882 when he resigned to become governor of Georgia. While in Congress he opposed the Civil Rights Bill of 1875, which aimed to extend certain social rights to the negro in the Southern States. He also objected to the methods of the Electoral Commission in 1877 and demanded that the fradulent returns be rejected; but when Hayes was declared elected Stephens advised acquiescence. He was elected governor of Georgia in 1882 by a majority of 60,000 over his opponent, a popular Confederate soldier, and made an excellent governor but died before the end of his term. In personal appearance Stephens was small and thin, never weighing over 90 pounds. His health was always poor but his disposition was cheerful. He was never married. Children and negroes especially were fond of him, and to the latter he was a trusted friend. He never blamed them for the excesses of the carpet-bag governments. He believed in the fundamental and natural inequality of the races; and Southern society and government are still based on the principle of his Savannah speech of 1861 in which he declared that the Confederacy was founded on that inequality. He was a logical and effective speaker, without the arts of the popular orator. Whig or Democrat his political principles were the same; he was a Democrat of the school of Jefferson believing in State rights, State sovereignty, strong local government and the largest liberty of the individual compatible with good government. It was difficult for him to understand that changed economic and social conditions should be reflected in changed political institutions. Therefore in his views of government he was a legalist rather than a political scientist. He published 'A Constitutional View of the War between the States' (1867-70); 'A School History of the United States' (1871); and a 'Compendium of the History of the United States' (1878-83). Though his 'Constitutional View' has great value as a historical document and all of his books are useful to show his views on politics and government, it cannot be said that he was successful as a historian, but rather as a lawyer, a politician and a statesman. Consult Johnston and Browne 'Life of A. H. Stephens' (1878; new ed., 1883); Cleveland, 'A. H. Stephens in Public and Private Life, with Letters and Speeches' (Philadelphia 1866); Pendleton, Lewis, 'Alexander H. Stephens' (ib. 1908); Trent, William P., 'Southern Statesmen of the Old Regime' (New York 1897); Avary, M. L. (ed.), 'Recollections of Alexander H. Stephens' (1910).

Walter L. Fleming,
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STEPHENS, Henry Morse, American historian: b. Edinburgh, Scotland, 3 Oct. 1857. He was educated at Haileybury College, and Balliol College, Oxford, and was engaged in journalism 1880-92. After being lecturer on Indian history at Cambridge University 1892-94, he was called to the chair of modern European and English history at Cornell University in 1892, which he held till 1902. Since the date last named he has been professor of history at the University of California. He is the author of a much valued 'History of the French Revolution' (1886-92); and of 'The Story of Portugal' (1891); 'Albuquerque' (1892); 'Revolutionary Europe 1789-1815' (1893); 'Syllabus of a Course of Lectures on Modern European History 1600-1890' (1899).

STEPHENS, James, Irish revolutionist: b. Kilkenny, 1824; d. Dublin, 29 March 1901. At 21 he went to Dublin and joined the young Ireland party. He was wounded at the fight at Ballingarry, 29 June 1848. In the next 12 years he became prominently known as a Fenian, and as such exercised an enormous and despotic influence, and throughout showed remarkable dexterity in the disguises and characters he assumed on his visits to all parts of Ireland. In 1863 he founded the *Irish People*, published in Dublin. He visited the United States early in 1864 to attempt to overthrow the rival schemes formed there by patriots, and was arrested in Dublin on 10 November of the same year, 14 days later making his escape from Richmond Bridewell. He found his way to New York, where, in 1867, he was formally deposed by the Fenians, and fled to Paris. He was allowed to return to Ireland in 1891.

STEPHENS, James, Irish poet and novelist: b. County Dublin, February 1882. After many difficulties in early life he became a solicitor's clerk in Dublin, and in his leisure engaged in the writing of verse and fiction, showing marked ability in both fields. He has contributed to *Sinn Fein* and to the *Irish Review*. Author of 'Insurrections' (1909); 'The Hill of Visions' (1912); 'The Charwoman's Daughters' (1912); 'Here Are Ladies' (1913); 'The Rocky Road to Dublin' (1915); 'Songs from the Clay' (1915); 'Reincarnation' (1918), etc.

STEPHENS, James Burton, Australian poet: b. Barrowstowness, Scotland, 17 June 1835; d. 29 June 1902. He was educated at the University of Edinburgh; and was a traveling tutor from 1857 to 1860, when he went to Queensland where he ultimately secured an appointment in the Colonial Secretary's Office at Brisbane. Later he became Under-Secretary of the department. During his spare time he wrote much and is considered one of the foremost of Australian poets. Among his published works are 'Convict Once and Other Poems' (London 1871); 'Black Gin and Other Poems' (Melbourne 1873); 'Mute Discourse' (Brisbane 1878); 'Miscellaneous Poems' (London and Brisbane 1880); 'Tayctle or Bush Revels' (Brisbane 1892); 'Poetical Works' (Sidney 1902).

STEPHENS, John Lloyd, American author: b. Shrewsbury, N. J., 28 Nov. 1805; d. New York, 10 Oct. 1852. He was graduated at Columbia College in 1822; studied law, and practised for eight years at the bar in New York. He made an extended journey through Europe and the East, an account of which he published in fuller narrative form under the title 'Incidents of Travel in Egypt, Arabia, Petræa, and the Holy Land' (1837); and 'Incidents of Travel in Greece, Turkey, Russia and Poland' (1838). In 1839 he was sent by the United States government to negotiate a treaty with the government of Central America; and as the result of his experiences and investigations in that country published 'Incidents of Travel in Central America, Chiapas and Yucatan' (1841); and after further exploration 'Incidents of Travel in Yucatan' (1843). He was one of the organizers of the first Atlantic steam navigation company and one of the first presidents of the company which constructed a railway across the Isthmus of Panama, and superintended the construction.

STEPHENS, Uriah Smith, American labor reformer: b. near Cape May, N. J., 3 Aug. 1821; d. in Europe, 13 Feb. 1882. He was educated for the Baptist ministry, but became a tailor, which calling he followed until his death. He was a lover of books and a close student of economic affairs, and sought through speeches and letters to the press to reform labor conditions in the United States and to further the cause of Abolition. In 1869 he founded the Knights of Labor and afterward devoted himself to the upbuilding of that order. He became the first Grand Master Workman of its general assembly in 1878.

STEPHENS, William, American colonial governor: b. Boscombe, Isle of Wight, 28 Jan. 1671; d. Georgia, August 1753. He was graduated at Cambridge in 1688, and before coming to America represented the Isle of Wight in Parliament. In 1736 he made the acquaintance of James Oglethorpe in South Carolina, and in the following year went to Georgia, where he was successful as a planter, and rose to prominence in the new community. In 1743 he was made president of the county of Savannah, and later governor of the entire colony. His administration lasted until 1750, when he resigned. He wrote 'A Journal of the Proceedings of Georgia from October 20, 1737,' a valuable historical work, but few complete

GEORGE STEPHENSON

First to apply the locomotive steam engine to railways for passenger traffic

copies of which remain. 'The Castle-builder, or the History of William Stephens of the Isle of Wight' (2d ed. 1759) is a biography by his son.

STEPHENS, William Richard Wood, English Anglican clergyman and author: b. Gloucestershire, 5 Oct. 1839; d. Winchester, 22 Dec. 1902. He was educated at Oxford, took orders in the Established Church, was vicar of Mid-Lavant, Sussex, 1870–73, rector of Woolbeding, Sussex, 1876–94, and dean of Winchester from the latter date. He published 'Saint Chrysostom: his Life and Times' (1872); 'Christianity and Islam' (1877); 'Hildebrand: his Life and Times' (1888); 'Life and Letters of Edward Augustus Freeman,' a work of much value (1895); 'The English Church from the Norman Conquest to Edward I' (1901).

STEPHENSON, stē'vĕn-sŏn, **George,** English inventor: b. Wylam, near Newcastle, 9 June 1781; d. near Chesterfield, 12 Aug. 1848. He was successively assistant fireman, fireman and brakeman in a colliery, in 1802 was made engineman at Willington Ballast Hill, in 1808 took with two others the contract to operate the engines at Killingworth pit, and in 1812 was appointed engine-wright there. The application of steam power to locomotive engines had for some time engaged the attention of scientific men. Stephenson eagerly devoted himself to the working out of the idea, and having established an extended reputation for soundness of judgment and engineering skill he was supplied by Lord Ravensworth with the means of constructing a locomotive engine, which was placed, 25 July 1814, on the colliery tramway, and drew eight loaded wagons at the rate of four miles an hour. Though thus partially successful, Stephenson saw that more was needed to make this mode of conveyance advantageous, and he accordingly invented the «steam blast,» which enabled him to double his rate of speed, and in 1815 he took out a patent for, and constructed, an engine which up to the present day (under certain modifications and improvements) has, like Watt's steam engine, continued as a model in the construction of locomotives. In this same year he devised a safety-lamp, the Geordie, for miners, which was produced prior to and altogether independent of the better-known invention of Sir Humphry Davy, and is still employed in preference to the latter in some parts of Northumberland. The following year he took out a patent for an improved form of rail and chair. In 1819 he was employed to construct a railway for the proprietors of the Hetton Colliery, and in 1822 the Stockton and Darlington line for Pease, its leading promoter, who appointed him resident engineer, with an annual salary of £300. The line was opened 27 Sept. 1825, the engine being driven by Stephenson himself, and drawing 38 carriages, with a total weight of about 90 tons, at a rate of from 12 to 16 miles an hour. This was the first steam railway in Great Britain on which passengers were conveyed as well as goods. At this period a copartnership was formed between Pease and Stephenson for the establishment of a locomotive manufactory at Newcastle, which was long the only work of the kind in the kingdom, and rapidly increased in extent and importance. The scheme of constructing a railway between Liverpool and Manchester had been set on foot in 1824, but the opposition to it, both in and out of Parliament, was so strong that it had to be temporarily abandoned. The bill was passed, however, on a second application, and the work commenced in 1826. After overcoming many difficulties, one of the greatest being the carrying of the line over Chatmoss, the railway was opened on 15 Sept. 1830. The results of the undertaking were most triumphant for Stephenson, and it proved the commencement of the British system of railroad transit. For 10 years subsequent to this there was scarcely a line of railway opened in Great Britain with the construction of which Stephenson was not concerned. In 1840 he resigned most of his appointments, and settled at Tapton, in Derbyshire, where he took in hand the working of the Clay Cross Collieries, leaving the extension of the railway system to be carried out by his son Robert (q.v.). He still, however, remained connected either as engineer or otherwise with several lines, made professional journeys to Spain and Belgium, and was created a knight of the latter country by King Leopold. He also took a considerable interest in mechanics' institutes, and was the founder and president of the Institution of Mechanical Engineers at Birmingham. George Stephenson may be regarded as an embodiment of the sturdy and energetic spirit which has raised the British nation to its high position industrially among the other countries of the world, and enabled it to effect such triumphs in enterprise. The standard authority is the 'Life' by Smiles as revised by that author for Vol. III of his 'Lives of the Engineers' (1862). See LOCOMOTIVE.

STEPHENSON, Robert, English civil engineer: b. Willington Quay, near Newcastle, 16 Oct. 1803; d. London, 12 Oct. 1859. He was the son of George Stephenson (q.v.). In 1822 he studied at Edinburgh University. The elder Stephenson having shortly after this engaged in the locomotive manufactory at Newcastle in conjunction with Pease, Robert became his apprentice in 1823, but his health giving way after two years, he accepted an engagement to examine the South American mines, returning to England in 1827 by way of the United States and Canada. Not long after his return he assisted his father and Henry Booth in the construction of the locomotive (the «Rocket») which gained the prize of £500 offered by the directors of the Liverpool and Manchester Railroad for the best railway engine. The next great work on which he was engaged was the construction of the London and Birmingham Railway, the first railway into London, of which he was appointed engineer. The first sod of the line was cut at Chalk Farm in June 1834, and the railway opened to the public in September 1838. Much of his attention was given to the superintendence of the manufactory at Newcastle, and he made frequent professional journeys abroad, laying out lines of railway in Switzerland, Germany and other parts of the Continent and likewise in Canada, Egypt and India. One of the most brilliant proofs of his engineering skill is displayed in the system of railway bridges and viaducts constructed under his directions. Among these may be mentioned more especially the high-level bridge at Newcastle, the Victoria bridge at Berwick, the tubular bridges, of which he was the inventor, as exemplified in those over the Conway and the Nile, and the still more wondrous erections of the Britannia bridge over the Menai Straits, and the Victoria bridge over the Saint Lawrence. He introduced the tubular girder system in the building of wrought-iron bridges. He took a considerable interest in public affairs, and from 1847 represented the borough of Whitby in Parliament. He served a term as president of the Institution of Civil Engineers, and his remains lie in Westminster Abbey. Consult Smiles, 'Lives of the Engineers' (Vol. III, 1862).

STEPHENSON, Mich., township and village in Menominee County, on a tributary of the Menominee River, 168 miles north of Milwaukee, Wis., on the Chicago and Northwestern Railroad. There are flour and lumber mills and a sugar beet industry. Pop. township, 3,000.

STEPHENSON'S DEPOT (CARTER'S FARM), Engagement at. On 19 July 1864 General Averell with 1,000 cavalry, 1,350 infantry and two batteries, marched up the Valley Pike from Martinsburg, W. Va., drove the Confederate cavalry from Darkesville toward Winchester, and halted near Stephenson's Depot, about six miles from Winchester. This placed him in rear of Early, who was at Berryville, who immediately retreated toward Strasburg, first sending Ramseur's division of infantry and two batteries to Winchester to support the cavalry brigades of Jackson and Vaughan, and check Averell's advance. On the morning of the 20th Averell, who had received a reinforcement of 300 cavalry, raising his force to about 2,800, resumed his march toward Winchester, in line of battle, to resist a sudden attack or to make one. A regiment of infantry was deployed on either side of the road, with skirmishers in advance, another regiment marched on each side in column in rear of the right and left flanks, artillery in the centre, on the road, and a regiment of cavalry on each flank. Three miles north of Winchester, on Carter's Farm, Ramseur was encountered, moving with intent to capture Averell, whose force had been reported as a regiment of cavalry and one of infantry. Ramseur opened fire with four guns and demonstrated with his cavalry on both flanks, under cover of which he formed line, Johnson's brigade on his right, Hoke's on the left, with Pegram's in reserve. Averell deployed his entire command in one line, withdrew his skirmishers, opened fire from his 12 guns, and, without pausing, sent in all his cavalry and infantry, drove in the Confederate cavalry, broke Ramseur's left, held by Hoke, which fled in disorder, followed by the remainder of the division to near Winchester, where Averell's immediate pursuit was checked by Jackson's cavalry. Averell captured four guns and about 280 wounded and unwounded prisoners, among them Generals Lewis and Lilly, wounded. Ramseur had 73 killed and 130 wounded. Averell had 53 killed, 155 wounded and six missing. Informed that a large force was gathering in his front, Averell established a strong picket-line and fell back two miles. On the morning of the 21st he entered Winchester unopposed, the Confederates having retreated toward Strasburg. On the 22d he was joined by Crook and next day both fought the battle of Kernstown (q.v.).

STEPNEY, a metropolitan borough of London, England, within the Parliamentary borough of Tower Hamlets. Area, 1,766 acres. The borough is typically east end, containing the districts of Whitechapel, Limehouse and Mile End, abounding in the most depressing poverty. Saint Katherine's and the London docks, the Tower of London and the Royal Mint, are situated within the borough. The People's Palace, Toynbee Hall, the London Hospital, Whitechapel and Dr. Bernardo's Homes are some of its institutions. Spitalfields is historically famous as a silk-weaving centre. There is a large foreign population, numbering about 53,060, of which 43,925 were natives of Russia or Russian Poland, out of a total of 63,105 of these nationalities in London. Pop. about 279,804.

STEPNIAK, stĕp'nyăk, **Sergius** (real name SERGIUS MICHAELOVITCH KRAVCHINSKI), Russian revolutionist and author: b. southern Russia, 1852; d. London, 23 Dec. 1895. After a liberal education, he identified himself with the revolutionary movement, was arrested in 1874 but released, and in 1880, on account of his advocacy of the "terrorist" policy, was compelled to leave the country. He went to Switzerland and later to England, became identified with the Socialists there and with the Social Democrats of the Continent, and wrote and lectured (also in the United States) on the liberalization of Russia. Among his books on conditions and methods were 'Underground Russia' (1882) and 'King Stork and King Log' (1896). His views altered from violent to constitutional means in securing popular freedom.

STEPPES, stĕps, Russia, a Tatar term employed geographically to denote those extensive tracts of land which, beginning at the Dnieper, extend along the southeast of Russia, round the Caspian and Aral seas, between the Ural and Altai mountains, and occupy a considerable portion of Siberia. These steppes present wide, treeless, monotonous tracts, which are covered with rough grass and shrubs during the short spring season, but soon become arid deserts owing to the drought of summer, and in winter are wastes of snow. Though they are all open, flat and treeless, they differ considerably in aspect according to the nature of the soil of which they are composed; some tracts consisting of deep, black earth, clothed with shrubs and grasses; others of hard, sandy clay and sterile; and others again of sand or rocky shingle and only here and there dotted with vegetation. This applies, however, only to the spring and early summer; for during the summer droughts all are alike desert save round the springs and streamlets, and during winter, which comes on in October, the whole is one exposed and inhospitable snow-waste. The Siberian plain, as might be expected from its extent, is of a more varied character, consisting of low-lying tundras, or black, swampy peat mosses, of broad undulating steppes and partially wooded uplands;

but the tundras and wooded lands are scarcely included in the steppes proper. From June till the middle of August the tundras are thawed to a small depth, the steppes are scantily covered with grass and mosses, the banks of the great rivers are green with the birch and pine and immense herds of horses and cattle give animation to the scene. In winter fearful storms rage and the dry snow is driven by the gale with a violence which neither man nor animals can resist.

STERCULIACEÆ, stĕr-kū-lĭ-ā'sę-ē, a family of dicotyledonous plants closely allied to the *Malvaceæ*, from which they are distinguished by the two-celled anthers. There are about 30 genera and 150 species, which comprise tropical and sub-tropical herbs, shrubs and trees with alternate, entire, lobed or digitately compound leaves, and generally axillary flowers which are often large and beautiful. They are also characterized by their mucilaginous qualities. Many are of economic importance, being used for food and for various other purposes. One of the best known species cultivated in the United States is the Chinese parasol tree, or Japanese varnish tree (*Sterculia platanifolia*), which is very popular in the southern States upon lawns and is often found wild. In California *S. diversifolia* and *S. acerifolia* are popularly planted upon lawns and in streets for their shade and showy flowers, which in the former species are yellowish-white or greenish-red, and in the latter brilliant scarlet, hence a popular name «flame-tree.» Both are natives of Australia.

STERE, stär, the French unit for solid measure, equal to a cubic metre or 35.3156 cubic feet. See WEIGHTS AND MEASURES.

STEREO-CHEMISTRY (Greek, *stereos*, «solid»). In the development of the science of chemistry, it was discovered that two or more compounds may have the same empirical formulæ and yet differ from one another in chemical and physical properties to a marked degree. Resorcin, pyrocatechin and hydroquinone, for example, all have the empirical formula $C_6H_4(OH)_2$, and yet they are distinctly different substances. Most cases of this kind are explainable by supposing that the constituent atoms are linked together in different ways in the several compounds; the compounds themselves being called «isomers,» and the phenomenon «isomerism.» (See ISOMERISM; AROMATIC COMPOUNDS; FATTY COMPOUNDS). The arrangement of the atoms in such compounds has been investigated in many of these cases, and «constitutional formulæ» have been devised for the purpose of representing the internal structures of their molecules. Compounds have been found to exist, however, which apparently have the same constitutional formulæ and which resemble one another very closely indeed in most respects, but which nevertheless exhibit certain differences in physical and chemical properties, so that they cannot be regarded as absolutely identical. It is the province of stereo-chemistry to investigate such bodies and to show how it is possible to reconcile their exceedingly close similarity with the existence of recognizable differences in certain respects. Isomerism of the kind here contemplated is commonly called «optical isomerism,» from the fact that the bodies that manifest it differ with respect to their action upon polarized light. It has long been known that certain crystals possess the power of rotating the plane of polarization of the light that they transmit. It is also known that the crystals of a substance that affects light in this manner may sometimes be obtained in two slightly different forms, which possess symmetry of the same kind, and whose corresponding angles are equal, but which differ in the same manner as a man's right hand differs from his left one, or as the image of an object as seen in a mirror differs from the object itself. A pair of crystals that differ only in this respect are said to be «enantiomorphous,» and if one of them rotates the plane of polarization to the right, the other, when similarly placed, will rotate it to the left; the angle of rotation being the same in each case, if the crystals are of equal thickness. If two such enantiomorphous crystals of the same substance are melted or dissolved, the respective fluids that are obtained from them are commonly found to be identical with each other in all respects, so that if they affect the plane of polarization at all, they rotate it in the same direction, and by the same amount. It is plain that in cases of this sort the differences between the original crystals are of a purely physical nature, depending only upon the way in which the molecules of the substance are grouped, and not at all upon the internal structure of those molecules. In other words, two enantiomorphous crystals are to be regarded as composed of identically the same chemical substance, if they differ only in their optical properties, and become identical in all respects upon being melted or dissolved. Stereo-chemistry has nothing to do with substances of this sort, which are not to be regarded as isomeric in any sense. Stereo-chemistry deals entirely with substances whose optical differences are manifested even in the liquid state, and hence are to be attributed to internal differences in the molecules rather than to mere differences in the grouping of the molecules among themselves.

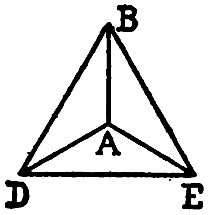


FIG. 1.

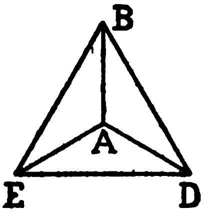


FIG. 2.

As a simple example of optical isomerism, the case of lactic acid and its isomers may be cited. Lactic acid (which occurs in sour milk, and which may be extracted in the form of a syrupy liquid) has no effect upon polarized light; but sarcolactic acid (which occurs in the juice of flesh) rotates the plane of polarization to the right, and yet its chemical properties are practically identical with those of common lactic acid. A third acid, known as «lævo-rotatory lactic acid,» has been prepared, which is almost indistinguishable from the two foregoing substances so far as its chemical properties are concerned, but which rotates the plane of polarization to the left. The chemical properties of all three agree with the constitutional formula $CH_3.CH(OH).COOH$; and yet they cannot be regarded as chemically identical. When polarized light is passed through equal thicknesses of equally concentrated solutions of sarcolactic and lævo-rotatory lactic acids, the plane of polarization is rotated in opposite directions, but by the same amount; and when equal quantities of sarcolactic and lævo-rotatory lactic acids are mixed, the mixture has no effect upon the plane of polarization, and (in fact) the mixture cannot be distinguished from ordinary lactic acid in any way. These general characteristics are manifested by all of the simpler optical isomers. They occur in pairs (or «twins»), one member of which rotates the plane of polarization to the right, while the other rotates it equally to the left. A third isomer also exists, which is composed of equal parts of the two optically active ones, and which is, therefore, itself inactive. The inactive member of the group is often called the «racemic» modification, the name being derived from racemic acid, which is an optically inactive mixture of dextro-rotatory and lævo-rotatory tartaric acids. (This statement, it is to be observed, applies only to the simpler cases of optical isomerism. For a more general statement, applicable in all cases, see below).

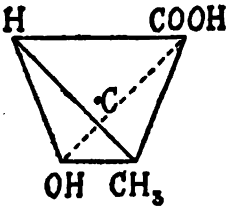


Fig. 3.

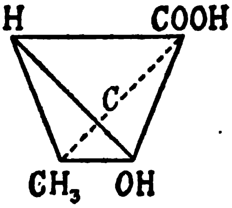


Fig. 4.

In 1874 Le Bel and van't Hoff, simultaneously and independently, pointed out that all known compounds which manifest optical isomerism contain at least one «asymmetrical» (or unsymmetrical) central atom. In most of the known cases, this central, asymmetrical atom is a carbon atom; but a few cases are now known in which it is nitrogen. The chemistry of asymmetrical nitrogen compounds is still in its infancy, however, and hence in the present article attention will be confined solely to the asymmetrical carbon atoms; and we shall first treat of compounds in which only one such atom is present.

Carbon is a tetravalent substance, having four valencies (or bonds); and it has been well established (especially by the exhaustive researches of L. Henry) that these four valencies of carbon are all alike, so that if one atom of hydrogen in methane (CH_4), for example, be replaced by one atom of any other monovalent substance, such as chlorine, the resulting compound is precisely the same, whichever of the hydrogen atoms is so replaced. The fundamental discovery of Le Bel and van't Hoff was that the simplest class of the substances which exhibit optical isomerism may be regarded as derived from methane, by substituting, for at least three of the hydrogen atoms that it contains, an equal number of monovalent atoms or radicals, no two of which are alike; so that the resulting compound consists of a central nucleus of carbon, each of whose valencies is satisfied by a different atom or radical. A carbon atom whose valencies are satisfied in this way is called an «asymmetrical» carbon atom.

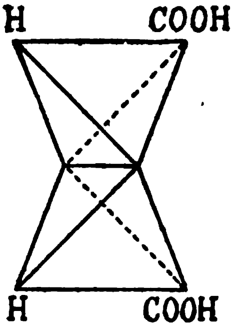


Fig. 5.— Maleic Acid.

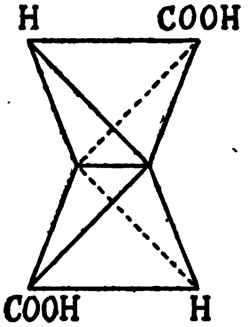
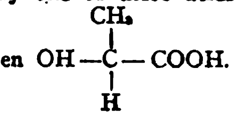


Fig. 6.— Fumaric Acid.

In the case of the various lactic acids which have already been cited, one of the fundamental hydrogen atoms of the methane remains undisturbed, while the other three are respectively replaced by OH, CH_3 and COOH. The structural formula of any one of these acids may, therefore, be written

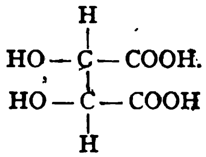


$$OH-\overset{\overset{\Large CH_3}{|}}{\underset{\underset{\Large H}{|}}{C}}-COOH.$$

The central carbon atom is here the «asymmetric» atom, since its four bonds are satisfied by four unlike univalent radicals or atoms. From the admitted equality and similarity of the four carbon bonds, it appears to be inadmissible to suppose that the nature of the compound that is represented above can depend (for example) upon whether the COOH group is opposite the OH group, or adjacent to it. Le Bel and van't Hoff, however, suggested that we should think of the four carbon bonds, not as four lines radiating out from the carbon atom in some one plane, but as lines radiating out from the carbon atoms in space, in four symmetrically related directions. The carbon atom being represented by a given point in space, for example, we are to think of the four bonds that it has as corresponding to the four vertices of an equilateral tetrahedron, having the carbon atom at its centre. For the sake of further illustration, let us suppose that we are looking down upon one of the vertices of such an equilateral tetrahedron, as suggested in Figs. 1 and 2; and let us represent the four dissimilar radicals (or atoms) by which the four bonds of the carbon are satisfied, by the letters A, B, D and E. We may suppose that in one of the optically active isomers these four radicals are disposed as in Fig. 1, and in the other as represented in Fig. 2. It is evident that two substances having such similar constitutions would be chemically so similar that it would be difficult to distinguish them by any ordinary test; and yet it is evident that they are not identical, since it will be found to be impossible to superpose either of these tetrahedra upon the other one, in such a way as to bring into coincidence all the vertices that carry similar radicals (or atoms). In fact, these two tetrahedra resemble each other enantiomorphically, just as the image of an object in a mirror resembles the object itself; and superposition is, therefore, impossible. The constitution of sarcolactic acid, according to this general scheme, might be represented as in Fig. 3, that of lævo-rotatory lactic acid being then represented as in Fig. 4. The central dot by which we have here represented the asymmetric carbon atom in each of these compounds is usually omitted from diagrams of this sort, the presence of this atom being sufficiently represented by the tetrahedron itself.

The name «stereo-chemistry» has reference to the use of a solid diagram for representing the constitutions of the compounds with which it is concerned; and the ideas which have been presented above are capable of being expanded into a general theory of the constitution of carbon compounds. The first successful attempt at the formulation of a theory of this sort was made by van't Hoff, in 1878. In this theory (which includes the explanation of isomerism of all kinds by the geometric relations of the solid diagrams that are used, and which is, therefore, often called the theory of «geometrical isomerism»), each carbon atom in a given compound is supposed to be represented by a separate tetrahedron; though in the practical applications of the theory it is customary to omit all the tetrahedra except those that relate to the central carbon atom, or to those which are of special or fundamental importance. When two carbon atoms are united by a single bond, their corresponding tetrahedra are supposed to be united in such a way that they are symmetrically situated, with one vertex in common; when they are united by two bonds, they are supposed to be symmetrically situated, with one edge in common; and when they are united by three bonds, they are supposed to have one entire face in common. In the case of the triple bond, the theory has no special interest; for in this case theory does not indicate any possibility of isomerism, nor has experiment revealed any case of this kind in which isomerism exists. The use of a solid diagram for illustrating the isomerism of compounds containing two carbon atoms united by a double bond will be understood from Figs. 5 and 6, which correspond, respectively, to maleic and fumaric acids. (See Maleic Acid). There is no optical isomerism in the case of these compounds; this circumstance being explained, according to the theory of geometrical isomerism, by the fact that the points of attachment of the hydrogen atoms and the COOH groups are in each case all in the same plane. Moreover there is no asymmetric carbon atom in either case, because if the tetrahedra were separated, they could be turned so as to be perfectly superposable. The relative distances between the points of attachment of corresponding radicals (or atoms) is not the same in Fig. 5 as in Fig. 6, and hence it is to be expected that the isomers that these diagrams represent will behave differently with respect to solubility, melting point, boiling point and in other respects also, including the facility with which they will react with other substances. It may be noted, in passing, that the atoms and radicals shown in Figs. 5 and 6 admit of still another arrangement, in which both of the hydrogen atoms are attached to one of the tetrahedra, and both of the carboxyl groups (COOH) are attached to the other one. The substance having this structure is actually known, and is called «methylene-malonic acid.» Its properties are quite different, however, from those of maleic and fumaric acids, as might be inferred from the markedly different character of its structural diagram.

Tartaric acid affords an interesting example in stereo-chemistry, not only on account of its structure, but also because it was upon this acid and its modifications that Pasteur performed the classical experiments which led (1860) to the development of the methods that are now used for the separation of optical isomers. The constitutional formula for tartaric acid as ordinarily written is



$$\begin{array}{c} \text{H} \\ | \\ \text{HO}-\text{C}-\text{COOH} \\ | \\ \text{HO}-\text{C}-\text{COOH} \\ | \\ \text{H} \end{array}$$

Each of the two central carbon atoms is here asymmetric, because each has its four bonds satisfied by four different substances. In the solid diagram for representing the structure of tartaric acid we shall, therefore, have to make use of two tetrahedra; and since the two nuclear carbon atoms are directly united by one bond, their corresponding tetrahedra will be symmetrically situated, and will have one vertex in common. In attaching the hydrogen, the hydroxyl (OH) and the carboxyl (COOH) to the vertices of the tetrahedra, we may adopt any one of three essentially different arrangements, for representing the relations expressed by the foregoing structural formula. These are shown in Figs. 7, 8 and 9. It will be observed, in Fig. 7, that the radicals and atoms that are attached to the vertices are so situated that the two tetrahedra would be superposable in all respects, if they were separated from each other. According to stereo-chemical theory, this signifies that the compound that Fig. 7 represents will rotate the plane of polarized light by an amount equal to the sum of the effects of the two constituent asymmetrical tetrahedra. Turning now to Fig. 8, it will be seen that the two tetrahedra in this diagram also admit of superposition upon themselves, if they are separated; and hence the compound that this diagram represents will also rotate the plane of polarization by an amount that is equal to the sum of the effects that are due to its two constituent tetrahedra. It will be noted, however, that neither of the tetrahedra in Fig. 8 can be superposed upon either of those in Fig. 7; and this fact (when taken in connection with the identity of the two types of tetrahedra in all other respects) signifies that the compounds that are represented by Figs. 7 and 8 will rotate the plane of polarization by equal amounts, but in opposite directions. Fig. 7 may, therefore, be taken to represent dextro-rotary tartaric acid, while Fig. 8 represents the lævo-rotatory variety of the same substance. In the configuration shown in Fig. 9, it will be observed that the two tetrahedra, if separated, cannot be superposed; for they are enantiomorphic, or respectively right-handed and left-handed. According to the theories of stereo-chemistry, one of these tetrahedra tends to cause the plane of polarization of polarized light to rotate to the right, while the other tends to rotate it by an equal amount to the left; and hence the substance, as a whole, will be optically inactive. In addition to these three varieties of tartaric acid (all of which are known and can be actually prepared), there is a fourth variety which is optically inactive, but which is not really chemically distinct from the varieties that have been described. This is known as «racemic acid,» and it consists of a mere mixture of equal parts of the dextro-rotatory and lævo-rotatory acids.

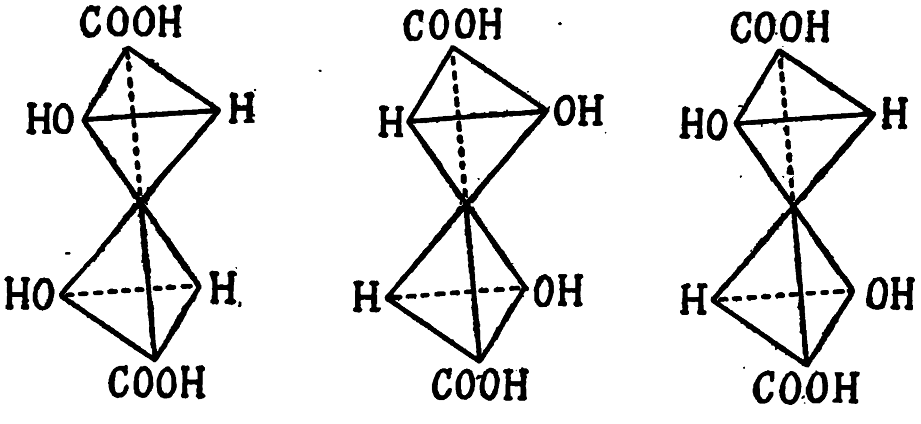


Fig. 7. Fig. 8. Fig. 9.

Constitution of the Isomers of Tartaric Acid.

The general facts of optical isomerism are thus stated by Nernst: (1) No compounds are optically active in the amorphorus, homogeneous state (whether solid, liquid or gaseous), save those which contain one or more asymmetrical carbon atoms in the molecule. (2) If several asymmetrical carbon atoms exist in the molecule,— for example, *two,* — then the rotations that are due to these respective atoms may be denoted by A and B, and the following combinations are possible, in the isomeric forms which the substance may exhibit:

$$A + B;\ -A - B;$$
$$A - B;\ -A + B.$$

The two substances corresponding to the first horizontal row are called «isomeric twins,» since they produce equal rotations, but in opposite directions. If the compound has n asymmetrical carbon atoms, then the number of optical isomers is $2n$, and two of these must be twins. (3) All compounds which contain asymmetric carbon atoms are not necessarily optically active; for the rotation that they produce may be too small to admit of detection; or the internal structure may be such as to produce internal optical compensation, as in the case of Fig. 9; or the compound may be a mixture of the dextro-rotatory and lævo-rotatory isomers, as in the case of racemic acid, already cited.

Optical isomers are often said to be identically alike in their chemical properties; but this is not rigorously true. The resemblance is exceedingly close, but certain slight differences are nevertheless observable, and these render the separation of the isomers possible. Special methods of separation may be adopted in special cases; but the three general methods that we have, and which are due to Pasteur, are as follows: (1) The mixed isomers are caused to combine with some other substance, whose isomeric compounds exhibit differences in melting point, solubility or crystallization; and when the compounds have been separated by the usual methods applicable in such cases, they are separately decomposed so as to liberate the isomers of the original substance again. Pasteur separated racemic acid into its constituents by neutralizing it with cinchonine, separating the respective salts by crystallization, and then decomposing the respective cinchonine salts so as to liberate the two active varieties of tartaric acid. Ordinary lactic acid may be separated into its constituents by making use of the different solubilities of the lactates of zinc. (2) Certain microscopic organisms affect the various isomeric forms in different ways. Thus the mold fungus, Penicillium glaucum, when allowed to act upon a dilute solution of ammonium racemate, destroys the dextro-rotatory tartaric acid, while leaving the lævo-rotatory variety unaffected. (3) Sometimes the compounds of the dextro-rotatory and lævo-rotatory isomers crystallize in separate enantiomorphous crystals, from which the crystals of one type can be picked out by hand. This method was used by Pasteur with success in the case of sodium-ammonium racemate; but it is not of very general applicability, because the isomeric salts usually separate out together, in one mass.

In conclusion it may be well to say that it is not at all probable that the atoms of carbon compounds are actually arranged in space in accordance with the geometric representations that are adopted in stereo-chemical theory. The tetrahedron diagrams are exceedingly useful for representing the chemical facts as we know them in the laboratory; but we know very little and perhaps nothing, of the actual way in which the atoms of compounds (whether carbon compounds or not) are arranged in space.

Consult Van't Hoff, 'Stereochemie,' and 'Dix années dans l'histoire d'une théorie'; Hantzsch, 'Grundriss der Stereochemie'; and Nernst, 'Theoretical Chemistry,' together with the references therein given.

Allan D. Risteen.

STEREOCHROMY, *in art,* a process of mural painting in which water glass is used to fix or consolidate the colors. See Painting, Technique of.

STEREOGRAM, Parallax, a novel photographic transparency, the invention of Frederic E. Ives, which, without a stereoscope or other optical aid, shows the objects photographed in full stereoscopic relief, when viewed from a certain point, directly in front. It consists of (1) a single photograph on glass which is a composite in alternate fine vertical lines of the two halves of an ordinary stereogram, and (2) of an opaque line cover screen mounted upon it, with a separation of about thirty one-thousandths of an inch. The relative disposition of the lines of the photograph and those of the cover screen is such that by parallax of vision, each eye sees those lines and only those which make up the image belonging to that eye. They can be so made as to show the objects apparently standing in the air, either through and beyond the glass or between the glass and the eyes. The large size of the photographs and the absence of any visible optical aid make the results more realistic and impressive than by other means of stereoscopic representation.

STEREOGRAPHIC PROJECTION, a name given that projection of the sphere which is represented on the plane of one of its great circles, the eye being situated at the pole of that great circle. All circles are projected either into straight lines or circles, and the angle made by two circles meeting on the globe is the same as that made by the projections of those circles. It is the projection generally employed in ordinary atlases. The distortion in the form of countries on the plane surface is very slight.

STEREOPTICON, a name given to a combination of two or three magic lanterns or optical lanterns arranged so as to focus in the same circle of light on the screen, for the production of what are termed «dissolving views.» The views are «dissolved» one into another by alternately throwing pictures from the two lanterns, the one gradually taking form while the picture from the other gradually fades upon the screen. With the oxy-hydrogen or calcium light the dissolving effect is produced by switching the gas from one lantern to the other. With the electric light it is done by revolving a shutter in front of the projecting lenses of the lanterns. This effect is much more beautiful with the calcium light, as the lime loses its brilliancy in the one lantern and acquires it in the other by degrees, the one view «melting» into the other. With the shutter the transformation is perceptible in a very unpleasant «winking» movement. Where the third lantern is added it is used independently to throw a second image upon a picture already on the screen, as in the case of a vision or dream, ghost or other phantasmagoria. It may also be used to tint delicately the view on the screen. See Magic Lantern; Optical Lantern.

STEREORITHES, stĕ'rē-ŏr'nĭ-thēz, a group of extinct birds of gigantic size, remains of which are found in Patagonia in the Miocene Age strata. They were distantly related to the herons and to the *Seriema.* The head was large with a high and powerful beak, and the palate was desmognathous.

STEREOSCOPE, an optical apparatus which enables us to look at one and the same time upon two photographic pictures nearly the same, but taken under a small difference of angular view, each eye looking upon one picture only; and thus, as in ordinary vision, two images are conveyed to the brain which unite into one, the objects being thus represented under a high degree of relief. The stereoscope is constructed in accordance with the visual phenomena which convey to the mind impressions of the relative forms and positions of an object. When a near object having three dimensions is looked at, a different perspective representation of it is seen by each eye; in other words, there is distinct binocular parallax. Certain parts are seen by the right eye, the left being closed, that are invisible to the left eye, the right being closed and vice versa, and the relative positions of the portions visible to each eye in succession differ. These two visual impressions are simultaneously perceived by both eyes, and are combined into one image, producing the impression of perspective and relief. If, then, truthful right-and-left monocular pictures of any object be so presented to the two eyes that the optic axes, when directed to them, shall converge at the same angle as when directed to the object itself, a solid image will be seen. This is effected with the stereoscope, a reflecting form of which was invented by Professor Wheatstone in 1838. It is constructed so that the two dissimilar pictures are reflected to the eyes from two small plane mirrors placed at right angles, the faces being toward the observer. Subsequently Sir David Brewster invented the refracting or lenticular stereoscope, based on the refractive properties of semi-double convex lenses; and this instrument, of which there are numerous forms, is now in general use. Convex lenses magnify the pictures besides producing a stereoscopic effect. Photography greatly assists the stereoscope in providing perfectly accurate right-and-left monocular views, which are taken simultaneously on a plate in a twin camera. Sometimes, in the case of objects which from their distance have no sensible binocular parallax, photographs are taken from two points considerably apart; and when such views are combined in the stereoscope the effect of relief is greatly exaggerated. A most interesting application has been made of this principle to the photography of comets, the position of the observer between the two exposures being greatly changed owing to the fact that the earth on which he stands is continually moving about the sun with a speed of more than 18 miles a second. Though the results are somewhat marred by the fact that the comet itself is moving, and also changing its shape, yet when the two pictures are combined, the stereoscopic effect is in many cases beautifully shown.

Several modifications of the reflecting stereoscope are distinguished by the names pseudoscope, iconoscope, telestereoscope and polistereoscope, the last being an apparatus which serves the purposes of all the others. See CAMERA; LIGHT.

STEREOSCOPIC SLIDE, a slip of cardboard on which are mounted side by side two photographs of the same scene or object, intended to be viewed through a stereoscope. Theoretically, these photographs should be taken by similar lenses from points of view separated by a space equal to the distance between the human eyes, but in practice — especially in dealing with architectural groups — the space is increased in order to procure a greater effect.

STEREOTROPE, a mechanism by which an object is perceived as if in motion, and with an appearance of solidity or relief as in nature. It preceded and suggested the moving pictures. It consists of a series of stereoscopic pictures, generally eight, of an object in the successive positions it assumes in completing any motion, affixed to an octagonal drum, revolving under an ordinary lenticular stereoscope, and viewed through a solid cylinder pierced in the entire length by two apertures, which makes four revolutions for one of the picture drum. The observer thus sees the object constantly in one place, but its parts apparently in motion, and in solid and natural relief.

STEREOTYPE, a printing plate cast in soft metal from a plaster or papier-maché mold, on which is a facsimile in reverse of a form of type, linotypes, cuts, etc., and which, when fitted to a block, may be used on a printing press exactly as movable type. For daily newspaper printing the stereotype is usually a curved plate, clamped directly on the surface of a printing cylinder. The stereotype process is rapid, but adapted only to coarse printing, the fine grades of printing requiring the electrotype (q.v.). See AUTOPLATE.

STERILITY is a condition which may be present in either sex where from various types of disorder there is incapacity to reproduce the species. In the male sex the spermatozoa may be absent in the semen or if present may be diseased and incapable of impregnating the ovum of the female. A practical type of sterility may arise from impotence in the male, whereby the consummation of the reproductive act is impossible. This is not a real sterility cause, technically speaking, but is practically so for certain matings, for many males are impotent with certain mates and not so for others. (See IMPOTENCY). The chief causes which render the male sterile are either anatomical defect of the genital apparatus producing an obstruction to the discharge of semen or to some disease of the testicles themselves. Absence of the testicles, accidental or induced (eunuchs), is a rare cause. Various inflammations of the testicles such as gonorrhœal orchitis, mumps orchitis or other type of testicular inflammation may destroy the spermatozoa or reduce their viability. Syphilis is also a frequent cause for reducing the capacity of the spermatozoa to fecundate the ovum. A large group of rare conditions related to the glands of internal secretion may cause sterility. (See SYNDROMES, ENDOCRINOUS).

A peculiar accidental type of sterility occurs among individuals exposed frequently to X-ray emanations. Some of these emanations or rays of light of very high wave velocity have an action upon the testicles causing loss of power to manufacture spermatozoa or to cause a loss of their fecundating power. The development of spermatozoa is largely regulated by the nervous system, and there are certain individuals who permanently or periodically are unable from nervous (mental) disturbance to manufacture viable spermatozoa. Little is known of this important group but recent researches in psychopathology are revealing the relationships between faulty affective reactions (psychoses and psychoneuroses) and the proper metabolic activities of the body which make healthy spermatozoa. This is an extremely large group and is classed, in general, by psychopathologists under the broad head of compensating neuroses. Here the individual's over-compensatory affective striving for social potency may so disturb the endocrinous functions as to bring about the results just described. This psychogenic basis for sterility affects both male and female and is to be seen in many individuals who show such symptoms as unusually eccentric individuals either vocational, such as professional, religious, artistic, mechanical, commercial, philosophic striving: Exaggerated sexual strivings as seen in pimps, seducers, white slavers. Eccentric penitentials, reformers, reconstructionists, hyperconscious individuals, obsessional, occultists, mystics, divine inspirationists. These over-compensatory strivings are frequently obvious in eccentric food habits, exhibitionistic clothing, eccentric modesty, grandiloquents, etc. The affective cravings cause hypertensions in the muscles, increased heart action, raised blood pressure, hyperactive adrenal glands, thyroid and liver activities and cause retrograde changes in the sex glands, thus impairing fecundity. This type of individual may be helped by the use of the organic endocrine extracts or by proper psychotherapy-psychoanalysis (q.v.).

In the female the causes for sterility are equally plentiful. These may be grouped as (1) failure of development of the ovary, uterus or other important parts of the reproductive apparatus. (2) Disease of the ovary, similar to diseases of the testicles, from syphilis, alcoholism, gonorrhœa, mumps and other inflammations. (3) Obstructions to the passage of the spermatozoa to the ovum or of the ovum to the uterus, the chief one of these is gonorrhœal disease of the fallopian tubes and is the one greatest single factor in causing sterility in the female. (4) Disease of the uterus lining membranes or of the vaginal membranes, causing changes in the chemisms of the secretions which destroy or weaken either the ovum or the spermatozoa or both. (5) The psychogenic factors already enumerated which may affect the vitality of the ovum through the nervous system mediated through the balance of endocrine function, or such affective disturbances can modify permanently or periodically the chemism of the vaginal or uterine secretions and destroy the viability of spermatozoa. Very minute variations in the chemistry of these secretions can prove disastrous to the viability of both ovum and spermatozoa.

In the determination of what factors may be operative in causing sterility of any given mating all of the factors enumerated may have to be investigated. The mechanical causes described are readily determined but the study of and amelioration of the psychogenic factors is extremely complicated and difficult. In the present state of knowledge many of these factors cannot be thoroughly comprehended. Consult 'American Textbook of Obstetrics for Mechanical Causes'; Falta, 'The Ductless Glands for Endocrine Disorders'; Kempf, 'The Autonomic Functions and the Personality for Psychogenic Mechanisms.'

Smith Ely Jelliffe, M.D.

STERILIZATION, in reference to human beings, an operation performed in order to deprive a man or woman of the power of reproduction. Many methods of sterilization might with greater propriety be termed asexualization, since they have certain harmful effects, both physical and mental. The general methods now employed are, in the male, vasectomy, or the removal of a portion of the seminal duct, and, in the female, salpingotomy, or the removal of a portion of the Fallopian tubes.

In the United States the sterilization of individuals is ordered by positive legal enactment for eugenic, punitive and therapeutic reasons. Indiana, in 1907, enacted the first sterilization law and Washington, California, Connecticut, Nevada, Iowa, New Jersey, New York, North Dakota, Michigan, Kansas and Wisconsin have since passed similar laws. The main object of such legislation is to prevent the procreation of habitual criminals, feeble-minded and insane persons. For an extended discussion of this subject, its advisability, the proper limitations, etc., consult Ellis, Havelock, 'The Sterilization of the Unfit' (in *Eugenics Review*, Vol. I, London 1909), and Laughlin, H. H., 'The Legal, Legislative, and Administrative Aspects of Sterilization' (in 'Eugenics Record Office, Bulletin No. 10B' (Cold Spring Harbor, N. Y., 1914).

STERILIZATION OF MILK. See Milk.

STERILIZED FOOD, any article of food which has been subjected to a sterilizing process that destroys the bacteria which cause fermentation and disease. Heat is the agent most commonly employed, and the process is more especially applied to milk. See Food Preservation; Milk — *Pasteurization*.

STERLING, John, Scottish author: b. Kames Castle, Isle of Bute, 20 July 1806; d. Ventnor, Isle of Wight, 18 Sept. 1844. He was graduated from Cambridge in 1824 and had attained some prominence in the literary world of London before his editorship with Frederick Denison Maurice of the *Athenæum* in 1828. In 1833 he published a novel, 'Arthur Coningsby,' and in 1839 'Minor Poems.' Three years later appeared 'The Election,' a poem, and 'Strafford,' a drama. His later work, accomplished during his years of declining health, includes also a series of prose poems published in *Blackwood's*, and eight cantos of 'Richard Cœur de Lion,' three of which were published posthumously in *Fraser's Magazine*, and were much praised by his friend, Carlyle. A collection of his essays and tales was published with a memoir by J. C. Hare in 1848. Consult Carlyle, 'The Life of John Sterling' (1851); also letters of Sterling and Ralph Waldo Emerson, with sketch of Sterling's life by Edward Waldo Emerson (1897).

STERLING, Thomas, American public official: b. near Amanda, Fairfield County, Ohio, 21 Feb. 1851. In 1875 he was graduated at Illinois Wesleyan University, was admitted to the bar three years later and in 1880–81 was city attorney of Springfield, Ill. In 1882 he removed to Spink County, S. D., and from 1901 to 1911 was dean of the College of Law of the University of South Dakota, afterward resuming his law practice. Mr. Sterling was member of the first state senate of the South Dakota legislature in 1890, and in 1913 was elected to the Senate of the United States.

STERLING, Colo., city and county-seat in Logan County, on the South Platte River, 118 miles northeast of Denver, on the Union Pacific and the Chicago, Burlington and Quincy railroads. It has a sugar beet factory and is a trade centre for sugar beets, alfalfa and livestock. Pop. 3,044.

STERLING, Ill., city in Whiteside County; on the Rock River, and on the Chicago and Northwestern and the Chicago, Burlington and Quincy railroads, about 110 miles west of Chicago and 50 miles northeast of Rock Island. Electric lines connect the city with many of the nearby places. It was settled in 1834 by Hezekiah Brink; and founded as two places, Chatham and Harrisburg, in 1837. In 1839 they were consolidated, and on 16 Feb. 1857 organized as the village of Sterling. In 1872 it was reorganized under the Illinois general law. Sterling is in a fertile agricultural and rich dairy region, and its excellent water power contributes to its manufacturing advantages. The chief industrial establishments are farm implements, nuts and bolts, wire factories, gas engine works, condensed milk, ice cream, candy, hearse factories, pump factory, foundries, machine shops, buggy factory, silver plating and hardware works. There are about 3,000 employees. There are 14 churches, a township high school, three graded schools, one parish school and one business college. One State, one savings and two national banks have a combined capital of $300,000. The government is commission form. Pop. (including Rock Fall) 13,000.

STERLING, Kans., town in Rice County, 225 miles west of Kansas City, on the Atchison, Topeka and Santa Fé and the Missouri Pacific railroads. Its industries comprise milling, grain elevators and salt making. There are three banks, with combined capital of $150,000 and deposits aggregating $600,000. The value of the taxable property is placed at $2,183,000. Sterling is the seat of Cooper College and has a high school, city hall and library. The government is carried on through common council. The municipal receipts average yearly $15,000. Pop. 2,300.

STERLING. A term used for the "standard" quality of English silver. The British sterling alloy proportion has varied at different times in the course of her history. For a long series of years the standard of silver (sterling) has been 11 ounces and two pennyweights of chemically pure silver alloyed with 18 pennyweights of copper; which is 37 parts out of 40 pure silver and three parts of copper, or, as commonly expressed, 222 parts pure silver to 18 parts alloy. As to the derivation of the term sterling this is a long-standing topic for controversy. Numerically, the preponderance of opinion is in favor of the word being derived from the Anglo-Saxon *easterling* or *esterling*. Some writers describe the conditions thus: The merchants of the Hanseatic cities and the Netherlands produced a better coinage than the degraded English pieces and King John (early 13th century) called in the services of the coiners (*moneyers*), who were known as «easterlings» or men of the East, to use their proficiency at the English mint; and the coins so struck were termed *esterling* or *sterling*. Camden (16th century) derives the word from easterling or esterling and observes that the money brought from Germany, in the reign of Richard I (end of 12th century), was the most esteemed on account of its purity, being called in old deeds «nummi easterling.» A statute of Edward I reads: «Denarius Angliæ qui vocatur sterlingas,» etc. (which translated means «the penny of England, which is called sterling»). Du Cange, in 1733, wrote: «Esterlingus, sterlingus, are words relating to money, and hence familiar to other nations, and applied to the weight, quality, and kind of money.» Documentary evidence informs us that the weight known as sterling was the equivalent of 32 grains of wheat. Pieces coined were double sterling, half sterling and quarter sterling. They were all of silver. The sterling *type* or face (see NUMISMATICS) consisted of a royal crowned head, some are full face, some are in profile; the *reverse* is «a large cross impaling the *legend* and is *cantoned* with 12 bezants.» This mintage was copied in Scandinavia, Holland, Flanders, in northern France, on the Rhine and Westphalia. The English sterling *type* (face) remained constant for the gros, penny, half-penny and farthing from Edward I (1272) till Henry VII (1485), and was the national type. In the scale of weights also the pound sterling was standard. After the middle of the 16th century sterling *type* disappeared from the English coinage which retained the term sterling. The Saxon pound sterling was divided into 20 shillings at 12 pence each, so that there are 20 shillings to one pound sterling. In her colonial financing guineas came into use for a time but have since given way to the pound sterling as standard of coinage. Some writers have considered the derivation of the term coming from *star* because the coins had a cross carrying four sceptres on its arms and looking like a star. But there are so many sides and direct facts connected with the word sterling that a learned Frenchman, J. Chautard, wrote a large work on the subject without exhausting the stock of material in hand; it is entitled ‘Imitations des Monnaies au Type Esterlin’ (Published in Nancy in 1874).

CLEMENT W. COUMBE.

STERN, Louis, American merchant: b. Germany, 22 Feb. 1849. He received a common school education at Albany, N. Y., and removing to New York established the well-known department stores of Stern Brothers. He was the Republican candidate for president of the borough of Manhattan in 1897; United States commissioner to the Paris Exposition of 1900; chairman of the executive committee, New York State commission to Louisiana Purchase Exposition (1904) and is president of the Republican Club. He is a member of the Metropolitan Museum of Art and of the American Museum of Natural History and president of the Hebrew Orphan Asylum.

STERNBERG, Constantin Ivanovitch Elder von, pianist, composer, educator and author: b. Saint Petersburg, Russia, 9 July 1852. He studied at the Leipzig Conservatory under Moscheles, Reinecke, Richter, Hauptmann and David in 1856–67; later under Kullak at the Berlin Academy of Music in 1872–74, also in Weimar and Rome under Liszt. Became conductor of operas in the Bruehl Theatre in Leipzig and assistant chorus master at the Municipal Theatre there from 1867 to 1869. In 1870 he conducted opera in Wurnburg, Kissingen and became conductor of the Court Theatre in Mecklenburg-Strelitz, 1873. Here intervened his study of the piano under Kullak and Liszt, and from 1875 to 1878 he was director of the Academic Music School and pianist to the Court at Mecklenburg-Schwerin, which positions permitted him to fill a large number of engagements for concerts in all the large music centres of Germany. In the following year his concert tours extended over the most of continental Europe, Russia, Asia Minor and part of central Asia, also northern Egypt. At the end of this tour he was summoned to play for Emperor William I, who distinguished him so markedly as to spread his fame across the ocean. He received and, after some hesitation due to his being engaged to marry, accepted an offer to play in the United States and Canada 100 concerts within five months. He was re-engaged season after season until 1886 his wife's ill-health obliged him to locate in the South (Atlanta, Ga.), where he conducted a college of music, which, however, did not prevent him from making several concert tours. His departure to Philadelphia (1890) called forth a public request to remain in Atlanta, which request, published in the *Constitution* (11 May 1890), was signed by the governor, the entire legislature of Georgia, the mayor of Atlanta and 150 of the prominent women of the State and city. Coming to Philadelphia he acquired full citizenship of the United States and founded the Sternberg School of Music, which has developed many pianists and composers who have gained national reputation. Withdrawing gradually from the concert stage he devoted his time to composition and has so far published over 300 pieces for the piano (many of which are in the concert programs of the present pianistic celebrities), a number of works for chamber music, which have had many public performances in Petrograd, Paris, Leipzig, Berlin and London, also several choral works and songs, amounting up to the present writing to 116 in opus numbers, many of these contain from 3 to 10 separate pieces. Sternberg is an accomplished linguist, the author of ‘Ethics and Esthetics of Piano Playing’ and a frequent contributor of essays to musical and other periodicals.

STERNBERG, stĕrn'bĕrg, **George Miller,** American surgeon: b. Otsego County, N. Y., 8

June 1838; d. 1915. He was graduated from the College of Physicians and Surgeons, New York, 1860. He was appointed assistant surgeon in the United States army, 28 May 1861; captain and assistant surgeon, 28 May 1866; major and surgeon, 1 Dec. 1875; lieutenant-colonel and deputy surgeon-general, 12 Jan. 1891; and received the commission of brigadier-general, and surgeon-general in 1893. He was retired 8 June 1902. His first service during the Civil War was with the Army of the Potomac and later with the Army of the Gulf. After the war he was in charge of the United States General Hospital in Cleveland, Ohio, served through yellow fever and cholera epidemics, and during the war with Spain (1898), had command of the medical service. He was a member of the Havana Yellow Fever Commission, sent there by the National Board of Health (1879), and president of the American Medical Association (1898). He has published ‘Photo-Micrographs, and How to Make Them’ (1883); ‘Bacteria, Malaria and Malarial Diseases’ (1884); ‘Manual of Bacteriology’ (1893); ‘Immunity, Protective Inoculations, and Serium-Therapy’ (1897); ‘Sanitary Lessons of the War’ (1912). In 1885 he was awarded the Lomb prize of $500 by the American Public Health Association for an essay entitled ‘Disinfection and Individual Prophylaxis Against Infectious Diseases.’

STERNBURG, Herman von Speck, German diplomat: b. Leeds, England, 21 Aug. 1852; d. Heidelberg, Germany, 24 Aug. 1908. He was educated at the Fürstenschule Saint Afra, Meissen, Saxony, and the military academy of Potsdam, fought through the Franco-Prussian War in the Second Saxon dragoons, and remained in the military service until 1885. In 1890 he entered on his diplomatic career, being made successively first secretary of legation at Peking, charge d'affaires at Belgrade, Servia, and first secretary of the embassy at Washington. In 1898 he was high commissioner on the Samoan commission; became consul-general for British India and Ceylon in 1900, minister plenipotentiary and envoy extraordinary to the United States in 1903, and ambassador in July 1903.

STERNE, stȩ̂rn, **Adolphus,** Texan pioneer: b. Cologne, Germany, 5 April 1801; d. New Orleans, La., 27 March 1852. Leaving his birthplace in his 16th year to escape military duty, he came to the United States, going first to New Orleans and then visiting Texas in 1824. A lover of adventure and proficient in many languages and dialects, he joined the English settlers in their early struggles against the Mexicans, and took part in the Fredonian War. Saved from being sentenced to death by an amnesty, he went into business at Nacogdoches, and became a notable figure in eastern Texas. He studied law, was court interpreter, and after Texas won her independence he served in both upper and lower houses of Congress.

STERNE, Laurence, English humorist: b. Clonmel, Ireland, 24 Nov. 1713; d. London, 18 March 1768. He was a great-grandson of Richard Sterne, the master of Jesus College, who attended Laud to the scaffold and afterwards became archbishop of York. The archbishop's third son, named Simon, married Mary Jaques, heiress to the lordship of Elvington, near York, on the river Derwent, and subsequently purchased Woodhouse Hall in the parish of Halifax. Their eldest son Richard succeeded to the two estates. Jaques, the third son, entered the church, and rose to many dignities, including an archdeaconry. Between them was born Roger Sterne, father of the humorist, who turned for a career to the army. When a mere stripling, Roger Sterne was appointed an ensign in the 34th regiment of foot and passed the rest of his life in service on the continent or in English and Irish barracks. He took part in the siege and capture of Vigo and in the defence of Gibraltar. In 1711 he married at Dunkirk, Agnes Hebert, of a humble Irish family and widow to a brother officer. Of their seven children only three lived beyond the fourth year. For 10 years the boy moved about with his parents from place to place, wherever the regiment happened to be stationed. Eventually the poor ensign left his family and went out to Jamaica, where he died of fever in 1731. As Laurence remembered him, Roger Sterne was "a little smart man . . . most patient of fatigue and disappointments . . . in temper somewhat rapid and hasty, but of a kindly, sweet disposition."

Long before this, Laurence had been placed, by the aid of his uncle Richard, in the Halifax grammar school, where he was kept at his accidence for some seven years, and then sent to Cambridge on an allowance of £30 a year. Laurence Sterne was admitted to Jesus College as a sizar in 1733, and the next year he was elected to one of the several scholarships founded by his great grandfather. At the university the young man in no way distinguished himself, and in after life he ridiculed the curriculum. Graduating A.B., in January 1736–37, he was ordained deacon in the following March. In 1738 he was admitted to the priesthood and obtained, through the influence of his uncle Jaques, the vicarage of Sutton-in-the-Forest, eight miles from York. To this preferment was soon added the neighboring Stillington and a prebendal stall in York minster. On 30 March 1741 he married Elizabeth, daughter to Robert Lumley, sometime rector of Bedale, and immediately settled in the parsonage at Sutton. He lived there for 20 years. Two daughters were born, of whom only Lydia reached maturity. Besides officiating in his two parishes and taking his turns at preaching in the cathedral, the vicar cultivated his glebe and purchased two farms for large crops of oats and barley. He amused himself with fiddling and painting, read hundreds of books on all sorts of subjects and visited extensively among convival squires. Possessing a facile pen, he wrote for a time political articles for his uncle Jaques, and twice he appeared in print with a sermon. A pamphlet called ‘A Political Romance’ (January 1795) brought to a gay close a hot dispute then waging in the York chapter. Aware now that he could write so as to make his reader laugh, he began ‘The Life and Opinions of Tristram Shandy, Gent,’ the first two volumes of which were given to the public in December 1759. In the following march Sterne went up to London and met his great fame. After seeing through the press a second edition of his book and two volumes of sermons, he returned to the north and settled at Coxwold, a parish at the foot of the Hambleton Hills, which had been bestowed upon him by Lord Fauconberg. In the parsonage there, renamed Shady Hall, Sterne went on with his comic romance, nine volumes in the whole, which appeared in further instalments near the beginning of several years down to 1767. Two more volumes of sermons were issued in 1765.

Never strong, Sterne broke down in January 1762, and hurried across the channel. After a brief stay in Paris, where statesmen, philosophers and the world of fashion crowded about him, he moved south to Toulouse, where he was joined by wife and daughter. He remained in southern France till the summer of 1764, when he returned alone to Coxwold. His health failing again, he set out for France in October 1765 on his famous sentimental journey. He traveled mostly by chaise from Calais via Montreuil to Paris, on to the south through Languedoc and then crossing over into Italy on to Rome and Naples. He was back at Coxwold in the summer of 1766. All this time his wife and daughter remained abroad. While in London for the winter of 1766–67, Sterne met and fell in love with Mrs. Elizabeth Draper, wife to a writer in the service of the East India Company. She sailed for India in April 1767 and poor Yorick was left broken-hearted. Mrs. Draper is the Eliza of the ‘Sentimental Journey’ and of a series of letters. After her departure for India, Sterne had a serious illness from which he barely recovered. In June he returned to Coxwold, where he recorded his sensations from day to day in a journal he kept for Eliza, and began ‘A Sentimental Journey through France and Italy.’ In the following January he went up to London with the new book, which was published on 26 Feb. 1768. He soon took to his bed and died 18 March 1768 at his lodgings in Old Bond street. At the time he was alone save for a nurse and a footman whom friends had sent to inquire after him. Four days later he was buried in Saint George's cemetery on the Bayswater road. According to a story which is probably true, his body was taken up and sold for dissection to the professors of anatomy at Cambridge. The next year Mrs. Sterne swept his study for three more volumes of sermons; and in 1775, Lydia, then Mrs. Medalle, brought out her father's letters and brief autobiography.

Stern's career appeals strongly to the imagination. An obscure country parson till his 47th year, he at once became known throughout western Europe. Everybody wished to see the man who had written ‘Tristram Shandy.’ In London and in Paris there always awaited him “dinners a fortnight deep.” A letter addressed to “Mr. Tristram Shandy, Europe,” was handed him by the postboy on the way to Sutton. When Lessing heard of Yorick's death, he said that he would gladly have given him five years from his own life. See Sentimental Journey, A; and Tristram Shandy.

Bibliography.— In 1780, Sterne's original publishers issued his work in 10 volumes. Of the numerous reprints, the best is the one edited by J. P. Brown (London 1873). It includes some additional letters. The convenient edition by Saintsbury (6 vols., London 1894) omits most of the sermons. The ‘Works and Life’ (12 vols., New York 1904), edited by Cross, contains the recently recovered ‘Journal to Eliza,’ additions to the correspondence, Mrs. Draper's letters to friends in England, a body of anecdotes, and the ‘Life’ (annotated) by Fitzgerald. This standard biography by Fitzgerald, published in 1864, was revised in 1896 and reprinted in 1905. Consult also Traill's ‘Laurence Sterne’ in ‘English Men of Letters Series’ (London and New York 1882); Stapfer's ‘Laurence Sterne, sa personne at ses ouvrages’ (Paris 1870), and Thackeray's ‘English Humorists.’ Of more special interest are Texte's ‘Rousseau et le cosmopolitisme littèrarie au XVIII ème siècle’ (Paris 1895), and Thayer's ‘Laurence Sterne in Germany,’ with a biliography (New York 1905).

Wilbur L. Cross,
Professor of English, Yale University.

STERNE, Simon, American lawyer and economist: b. Philadelphia, 23 July 1839; d. New York, 22 Sept. 1901. He studied at the University of Heidelberg, was graduated from the law department of the University of Pennsylvania in 1859, and was admitted to the bar of New York in 1860. He represented many corporate interests, and paid special attention to real estate and constitutional law. He found time to take part in social and civic reform, lectured on political science at Cooper Institute (1861–63), and was secretary of the committee of 70 for the overthrow of the Tweed Ring (1870). He was appointed in 1875 on a commission to devise plans for the government of cities, and in 1895 on a commission to recommend changes in methods of administration; and by President Cleveland in 1896 to report as to the relations of western European governments to railways. Besides a large number of articles on historical and political economic subjects, he published ‘Representative Government’ (1871); ‘Suffrage in Cities’ (1878); ‘Hindrances to Prosperity’ (1879); ‘Constitutional History and Political Development of the United States’ (1882); ‘Railways in the United States’ (1912). Consult Foord, ‘Life and Public Services of Simon Sterne’ (1903).

STERNER, Albert Edward, American artist: b. London, England, 8 March 1863. He studied at Julien's Academy and the Ecole des Beaux Arts, Paris, and in 1881 came to the United States, opening his studio in New York in 1885. He is best known for his illustrations, which are effectively drawn and possess refinement and charm, while notable among his oil paintings are ‘The Bachelor’ and ‘Portrait of My Son.’ He became an associate of the National Academy of Design in 1910, and instructor at the Art Students' League and the New York School of Applied Design for Women.

STERNHOLD, stėrn'hōld, **Thomas,** English hymnologist: b. Blakeney, Gloucestershire, about 1500; d. 1549. He was one of the versifiers of the first metrical version of the Psalms, long used in public worship in churches, but superseded by the version of Tate and Brady, published in 1698. He was educated at Oxford, became groom of the robes to Henry VIII, and held a similar office under Edward VI. The principal coadjutor of Sternhold in his versification of the Psalter was John Hopkins. The first edition (1548) contained 19 psalms, the second (1549) 37 psalms, translated by Sternhold, the third (1551) includes 7 translated by Hopkins. In 1562 appeared 'The Whole Book of Psalms.'

STERNUM, the breastbone in vertebrates. See ANATOMY, COMPARATIVE; ORNITHOLOGY; OSTEOLOGY.

STERRETT, James Macbride: b. Howard, Pa., 13 Jan. 1847. He graduated A.B., University of Rochester, 1867; A.M., Harvard University, 1870; B.D., Episcopal Theological School, Cambridge, Mass., 1872; D.D., University of Rochester, 1886. He was ordained in the Protestant Episcopal Church, 1872; served in Brooklyn, Wellsville, N. Y., and Bedford, Pa., 1872–1882; professor of ethics and apologetics in the Seabury Divinity School, Faribault, Minn., 1882–92; professor of philosophy in the George Washington University, 1892–1909; professor emeritus on The Carnegie Foundation, 1909; president, Society for Philosophical Inquiry, 1893–1910; rector of All Souls' (Sterrett) Memorial Church, 1911. He is author of 'Studies in Hegel's Philosophy of Religion' (1889); 'Reason and Authority in Religion' (1891); 'The Ethics of Hegel' (1893); 'The Freedom of Authority' (1905).

STERRETT, John Robert Sitlington, American educator and classical scholar: b. Rockbridge Baths, Va., 4 March 1851; d. 1914. He was educated at the universities of Virginia, Leipzig, Berlin, Athens and Munich. After holding professorships of Greek at Miami University and the University of Texas he was called to Amherst College, 1892–1901; he became head of Greek department at Cornell University, 1901. He was a professor in the American School of Classical Studies at Athens, Greece, 1896–97, led various archæological expeditions to Asia Minor, and was a joint editor of the *American Journal of Archæology*. Among his publications are 'Qua in re Hymni Homerici quinque majores inter se differunt' (1881); 'Inscriptions of Tralles' (1885); 'Notebook of a Traveling Archæologist' (1889); 'The Torch-race' (1902); 'Research in Asia Minor and Syria' (1911).

STESICHORUS, stē-sĭk'ō-rŭs, Greek poet: b. Himera, Sicily, or perhaps Locrian Mataurus, Italy, about 640 B.C.; d. Catana, 555 B.C. His own name, Tisias, he changed to Stesichorus ("conductor of the choric ode") as the inventor of strophe, anti-strophe and epode. With his predecessor, Alcman, he stands at the head of Dorian poets of the lyric dance. He incurred the wrath of Phalaris by the warning and poetic appeals which he addressed to his townsmen in view of the tyranny of that prince and died in exile. He employed folk-tales, the impersonal love poem and Epic-Doric dialect. He is considered one of the powerful influences in Greek poetry. He gave life and secular force to the Greek religious hymn, by giving it and his other poetry a more epic expression and form; and he is looked upon as the forerunner of Greek romance. He also set the style and versification for Greek lyric poetry so firmly that they suffered little subsequent change. His fragments are collected in Bergk's 'Poetæ Lyrici Græci.' Consult Farnell, G. S., 'Greek Lyric Poetry' (London 1891); Smyth, H., 'Greek Melic Poets' (London 1900); Wright, W. C., 'A Short History of Greek Literature' (New York 1907).

STETEFELDITE, a mineral containing silver with copper, iron, antimony and sulphur. An ore of some importance in Klondike district, Nevada.

STETHOSCOPE, an instrument, the invention of Lænnec (q.v.), originally consisting of a short wooden tube, from 7 to 12 inches long, widening toward each end, with which physicians sounded the lungs by pressing on the chest or back and listening; also for diagnosing hernia, pregnancy, etc. The modern form of the instrument has two ear-tubes with flexible attachments, so that the physician hears simultaneously with both ears. The differential stethoscope permits comparison of sounds in different parts of the body. Another improvement is the phonendoscope, which renders audible more minute sounds.

STETSON, Francis Lynde, American jurist: b. Keeseville, N. Y., 23 April 1846. He was graduated at Williams College in 1867, took his LL.B. at Columbia University in 1869 and was admitted to the bar. He engaged in practice in New York and became known as an authority on corporation and railroad law. He was retained as general counsel by the United Steel Corporation, the International Mercantile Marine Company, the Northern Pacific and the Southern railroads, and the United States Rubber Company. He is also a railroad and corporation director. He is a trustee of Williams College and a director of the New York Botanical Gardens.

STETSON, John Batterson, American philanthropist: b. Orange, N. J., 5 May 1830; d. near Deland, Fla., 18 Feb. 1906. He engaged in hat manufacture and founded the John B. Stetson Company, with the largest factories in the world. Connected with them are reading-rooms, library, armory, etc. He built Stetson Hall for Deland University at Deland, Fla., and added other endowments, the name of the institution being changed to the John B. Stetson University.

STETTIN, stĕt-tēn', Germany, in Prussia, capital and port of Pomerania, and of the government of Stettin, on the Oder, 60 miles northeast of Berlin. The old and new towns are distinct sections. Since the removal of the fortifications (1873) the town has extended greatly and several outlying villages have become incorporated in the main town. Both the Oder and the Parnitz, a tributary, are spanned by several bridges. There are numerous public squares embellished by statues of German sovereigns and other celebrities. There are many churches, of which the churches of Saint James (14th century) and Saint Peter's (1124) are most noteworthy, also a fine synagogue. Of secular buildings may be mentioned the royal palace (1346), now used for government purposes; the old town-hall, the exchange, asylum, orphan-home, concert-hall and club, arsenal, schools of architecture, technical school, etc. Stettin is one of Germany's chief ports and an important shipbuilding centre. The industries are varied and include iron-foundries, engineering works, manufacturing of ready-made clothing, chemical, cement, soap, oil, paper and pasteboard works, sugar refineries and famous breweries and distilleries. In 1898 a free harbor east of the Lastadie suburb was opened, and in 1900 another new harbor on the east bank of the Oder. A ship-canal connects Stettin with Berlin, and ocean-going vessels now load and unload at its docks. The imports include coal, iron, soda and potash, seeds, coffee, cotton, wine, corn, herrings, timber; the exports are sugar, timber, liquor, grain, potatoes and flour. In the 12th century Stettin had already attained considerable importance. In 1121 Boleslas, Duke of Poland, introduced Christianity. The Treaty of Westphalia ceded the town to the Swedes, and it subsequently became a possession of Prussia. Pop. 257,400.

STEUART, stū'art, **John Alexander,** Scottish novelist: b. Perthshire, 3 July 1861. After traveling extensively in North America he entered journalism, and returning to Europe settled in London and was editor of *The Publishers' Circular* (1896–1900). He has published 'A Millionaire's Daughters' (1888); 'Letters to Living Authors' (1890); 'The Eternal Quest' (1901); 'A Son of God' (1902); 'The Hebrews' (1903); 'The Red Reaper' (1905); 'Quicksands' (1907); 'Faces in the Mist' (1911); 'The Rock of the Ravens' (1912); 'Cupid, V. C.' (1916).

STEUBEN, stū'bĕn (Ger. stoi'bĕn), **Friedrich Wilhelm August Heinrich Ferdinand,** Baron von, Prussian soldier and American general: b. Magdburg, Prussia, 15 Nov. 1730; d. Steuben, Oneida County, N. Y., 28 Nov. 1794. Before coming to America he had attained the rank of lieutenant-general in the Prussian army, and had won distinction in the Seven Years' War. At its close he retired from military life, but was persuaded by colonial representatives in France to come to the assistance of the American people. He at once became an enthusiastic supporter of the American cause, and, tendering his services to Congress in 1777, was assigned to the main army under Washington at Valley Forge. His splendid discipline and ability as an organizer were at once recognized by Washington, who recommended his appointment as inspector-general of the entire army. Unable to attain a separate command in the open field, he spent most of his time recruiting the forces sent to those who took a more prominent part in the war; but it was undoubtedly due to his almost unrecognized efforts that the American troops were from the first so well organized and disciplined a body. He attained at last his coveted place as an officer in the line, and as major-general of the forces at Yorktown received the first offer of capitulation from Lord Cornwallis. Refusing to be relieved by Lafayette, he was allowed to remain with his command until the complete surrender of the enemy. At the close of the war he was refused pecuniary remuneration which he had asked of the colonies in the event of their success, but to recuperate his fortunes, abandoned for their cause, was subsequently awarded several grants of land, among them a township in northern New York, where he spent the remainder of his life in a log-cabin, within the present limits of Utica, N. Y., and where a monument to his memory was unveiled 3 Aug. 1914. Consult Sparks, 'American Biography'; Kapp, 'Life of Steuben' (1860).

STEUBENVILLE, stū'bĕn-vil, Ohio, city, county-seat of Jefferson County, on the Ohio River, and on the Pittsburgh, Chicago, Cincinnati and Saint Louis, the Cleveland and Philadelphia division of the Pennsylvania, the Wabash (Wheeling and Lake Erie) railroads, about 68 miles below Pittsburgh, Pa., and 23 miles north of Wheeling, W. Va. In 1786 a fort was built on the site of the present city. In 1798 the place was laid out as a town, and in 1851 it was incorporated as a city. It was one of the first American towns to use steam for manufacturing purposes.

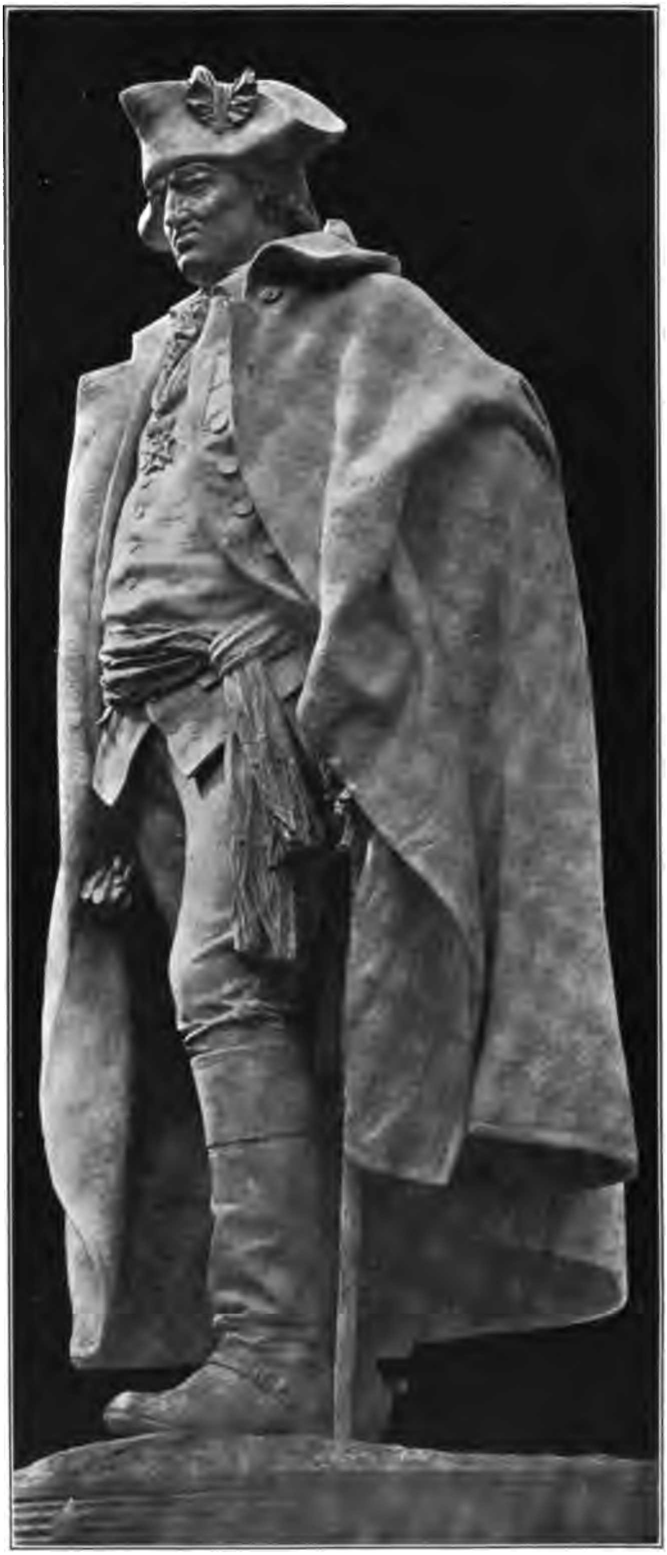
The city is in an agricultural and coal and gas region, and has valuable clay deposits, petroleum wells and large quarries of excellent building stone. The chief manufacturing establishments are iron and steel, soap, tin plate and clay works, potteries, foundries, glass factories, blast furnaces, a paper mill, flour mills, boiler and tube works, machine-shops and nail and electric light furnishings and factories.

The city possesses numerous good churches, a high school opened in 1860 and public and parish schools, private commercial colleges, a Carnegie public and school libraries. It has four regular banks and two private banks and two building and loan associations. Pop. about 28,000.

STEUNENBURG, Frank, American statesman: b. Keokuk, Iowa, 8 Aug. 1862; d. December 1905. He removed to Caldwell, Idaho, in 1887, and engaged in the newspaper business. In 1889 he was a member of the convention which framed the State constitution, and in 1890 he was elected to the State legislature. He was elected governor of Idaho by the Populist party in 1898, and served in that capacity until 1901. He was assassinated by Harry Orchard (q.v.) in 1905, because of enmity engendered by his handling of the miners' strikes during his administration.

STEVENS, Abel, Methodist Episcopal clergyman and author: b. Philadelphia, Pa., 19 Jan. 1815; d. San José, Cal., 12 Sept. 1897. He studied at Wesleyan University, entered the New England Conference of the Methodist Episcopal Church in 1834, and held pastorates at Boston, Mass., and Providence, R. I. He was editor of *Zion's Herald* in 1840–52, of the *National Magazine* in 1853–54 and of the *Christian Advocate* in 1856–60. He returned to active duty as a pastor in New York and Mamaroneck, N. Y., in 1860–65, and in 1865–74 was joint editor of the *Methodist*. He subsequently traveled extensively in Europe, and was for a time in charge of the American Union Church at Geneva, Switzerland. His writings on the history of Methodism are exhaustive and authoritative. Author of 'Memorials of the Introduction of Methodism into the Eastern States' (2 vols., 1847–52); 'History of the Religious Movement of the Eighteenth Century, Called Methodism' (3 vols., 1858–61); 'The History of the Methodist Episcopal Church in the United States of America' (4 vols., 1864–77); 'A Compendious History of American Methodism' (1867); 'Madame de Stael' (2 vols., 1881); 'Christian Work' (1882), etc.

STEVENS, stē'vĕnz, **Alfred,** Belgian painter: b. Brussels, 11 May 1828; d. Paris, France, 24 Aug. 1906. He studied under Navez



STATUE OF BARON VON STEUBEN

at Brussels and Roqueplan at Paris, and won a first-class medal at the Paris Exposition of 1867. He soon evinced striking talent in portraying fashionable and elegant life in Paris of the day — such as the lady in her boudoir, with all the bright, piquant accessories added in a spirit as suggestive, but not so bitter as that which characterized Hogarth, although his later pictures which take their subjects from common life had a distinctly ethical motif. Among his best-known canvases are ‘The New Year's Gift’; ‘Innocence’; ‘The Allegory of Spring’; ‘The Visit’; ‘The Parisian Woman turned Japanese,’ and ‘Morning in the Country’. He also painted for the king of the Belgians four figures in fresco representing the four seasons, — female figures in modern costume. His ‘Five O'Clock Tea’ is in the Vanderbilt collection, New York.

STEVENS, Alfred George, English sculptor: b. Blandford, Dorsetshire, 1818; d. London, 1 May 1875. He was educated at the village school, and for a time followed his father's trade of house-painter. The assistance of a friend enabled him to study painting, architecture, and sculpture in Italy, where he lived from 1833 till 1842, being for some time a pupil of Thorwaldsen. After his return to England he became a teacher for two years in the School of Design. He is to be looked upon as one of the most important figures in the history of English sculpture. He was a follower of Michelangelo and the Renaissance, yet broke completely with the English tradition of stiff classicality, and worked naturally and freely at the dictates of his own individuality, bringing about something like a revolution in the ideals of English statuary. His influence was more active after his death, and during his lifetime his genuine strength and greatness were only known to the few. His great work is the monument to the Duke of Wellington in Saint Paul's. Consult Stannus, ‘Alfred Stevens and His Work’ (1891); Armstrong, ‘Alfred Stevens: a Biographical Study’ (1881).

STEVENS, Benjamin Franklin, American bibliographer, brother of Henry Stevens (q.v.): b. Barnet, Vt., 19 Feb. 1833; d. London, England, 5 March 1902. He studied at Middlebury College, and in 1860 went to London to engage with his brother Henry in his rare book business. He made a chronological catalogue of the American documents of the period 1763–84 in England, France, Holland and Spain, and likewise secured facsimiles of many important manuscripts concerning American history. For many years he was in charge of the Chiswick Press, and he was agent for many American libraries, as well as being United States dispatch agent in London. His publications include ‘American Manuscripts in European Archives’ (1887); ‘The Campaign in Virginia in 1781’ (2 vols., 1888); ‘Facsimiles of Manuscripts in European Archives Relating to America, 1773–1783’ (25 vols., 1889–98), etc.

STEVENS, Bertram, Australian author and critic: b. Inverell, New South Wales, 9 Oct. 1872. He entered journalism and became editor of a literary section called the ‘Red Page’ (in the Sidney *Bulletin*, 1909–11); and editor of the Australian magazine, *The Lone Hand* (1911–18). He has written and published much on literary matters and has made two anthologies of Australian poetry, ‘Anthology of Australian Verse’ (1906) and ‘Golden Treasury of Australian Verse’ (1908). Among his other publications are ‘Australian Birthday Book’; ‘Bush Ballads’; ‘The Charm of Sydney’; ‘The Poetical Works of John Farrell, with Memoir’; ‘Verses by Victor Daley, with Memoir.’

STEVENS, Ebenezer, American soldier: b. Boston, 1751; d. 1823. He was one of the Massachusetts colonists who took part in the memorable demonstration in Boston harbor in 1773, and was an active revolutionist from 1775 to the close of the war, during which he raised three Massachusetts companies for the siege of Quebec, and served as a commander in the battles of Ticonderoga, and later in the Virginia campaign. In 1778 he became lieutenant-colonel. He was also an officer in the War of 1812, engaged in the defense of the New York frontier. Later he was successful as a merchant in New York.

STEVENS, Edward, American soldier: b. Culpeper County, Va., 1745; d. there, 17 Aug. 1820. In 1776 he became colonel of the 10th Virginia regiment, the next year checked the forces of General Howe at the battle of the Brandywine, and after serving with distinction at Germantown, was appointed brigadier-general (1779). He served later at Camden, Guilford Court House, and at the siege of Yorktown, his gallantry being highly commended. After the adoption of the Virginia State constitution he was a member of the State senate till 1790.

STEVENS, Edwin Augustus, American inventor, capitalist and shipbuilder, son of John Stevens (q.v.): b. Hoboken, N. J., 1795; d. Paris, 7 Aug. 1868. He made numerous experiments in steam navigation and in 1861 urged the government to put into service his projected ironclad of 6,000 tons. This was not done and this first ironclad was never finished. The construction of this vessel was begun in 1854, under authorization by Congress; and $1,000,000 left in Stevens' will to finish it was spent after his death in 1868. Finally the boat was sold for scrap iron in 1880. He inherited a large fortune from his father and his brother and endowed the Hoboken high school, and bequeathed $1,000,000 to establish at Hoboken the Stevens Institute of Technology (q.v.). He was one of the foremost railroad organizers of the United States.

STEVENS, Edwin Augustus, American mechanical engineer, son and namesake of the founder of the Stevens Institute of Technology (q.v.): b. Philadelphia, 14 March 1858. He was graduated at Princeton in 1878 and has since resided at Hoboken, N. J., where he has been director and trustee in various corporations. He designed the first screw ferry-boat.

STEVENS, Frank Lincoln, American plant pathologist: b. Syracuse, N. Y., 1 April 1871. He was graduated at Hobart College in 1891, at Rutgers in 1893, later studied at the Ohio State University and took his Ph.D at the University of Chicago in 1899; he also studied at the universities of Bonn and Halle, and at the Naples Zoological Laboratories. In 1902–12 he was professor of botany and plant pathology at the North Carolina College of Agriculture and Mechanical Arts, also serving for a time as biologist of the North Carolina Agricultural Experiment Station. He was dean of the College of Agriculture and Mechanical Arts at the University of Porto Rico in 1912–14; and since 1914 has been professor of plant pathology at the University of Illinois. He was president of the American Phytopathological Society in 1910. Joint author of 'The Hill Readers' (1906); 'Diseases of Economic Plants' (1910); and author of 'The Fungi Which Cause Plant Disease' (1913), etc.

STEVENS, George Barker, American professor of theology: b. Spencer, N. Y., 13 July 1854; d. New Haven, Conn., 22 June 1906. He was graduated from the University of Rochester in 1887; held pastorates in a Congregational and Presbyterian church, 1880–85; studied in Germany, 1885–86; and became professor of New Testament criticism at Yale University in 1886. From 1895 till his death he was Dwight Professor of Systematic Theology in the Yale Divinity School. His publications include 'The Pauline Theology' (1892); 'The Johannine Theology' (1894); 'The Message of Paul' (1900); 'The Message of the Apostles' (1901); 'The Christian Doctrine of Salvation' (1905); 'The Theology of the New Testament' (1899); 'The Teaching of Jesus' (1909).

STEVENS, Henry, American bibliographer, brother of B. F. Stevens (q.v.): b. Barnet, Vt., 24 Aug. 1819; d. South Hampstead, England, 28 Feb. 1886. He studied at Middlebury College, at the Harvard Law School and was graduated at Yale University in 1841. He became interested in the bibliography of early American history and genealogy, and in 1845 went to London to execute a number of commissions for collectors of such works. He lived there the remainder of his life. He was agent of the British Museum to procure for it books and manuscripts produced in both North and South America, and through his efforts the Museum's collection of Americana was at the time the largest in the world. He collected for the Lenox Library, New York; and his collection of documents relating to Benjamin Franklin was purchased by the United States government. His bibliographical catalogues are of great value, being of rare accuracy and most minute in detail. He published many essays and pamphlets and edited many works on American history. He wrote 'Catalogue of a Library of Works Relating to America' (1854); 'Catalogue of the American Works in the Library of the British Museum' (1859); 'Bibliotheca Historica' (1870); 'Bibles in the Canton Exhibit' (1878); 'Historical Collections' (2 vols., 1881–86), etc.

STEVENS, Isaac Ingalls, American military officer: b. Andover, Mass., 18 March 1818; d. near Chantilly, Va., 1 Sept. 1862. He was graduated at the United States Military Academy in 1839, and served in the Mexican War as adjutant of engineers. From 1849 to 1853 he was in charge of the coast survey at Washington. In 1853 he resigned from the army to become governor of Washington Territory. At the outbreak of the Civil War he was made colonel of the 79th New York regiment. He was made a major-general 4 July 1862. He was killed while leading a charge at Chantilly. He wrote 'Campaigns of the Rio Grande and Mexico' (1851).

STEVENS, John, American engineer and inventor: b. New York, 1749; d. Hoboken, N. J., 6 March 1838. He was graduated in law in 1771. In 1787, having accidently seen the imperfect steamboat of John Fitch, he at once became interested in steam propulsion, and experimented constantly for the next 30 years on the subject. In 1789 he petitioned the legislature of New York for a grant of the exclusive navigation of the waters of that State. The petition was accompanied with drafts of the plan of his steamboat, but the right was not granted because the boat did not meet the exactions made by Congress. The following year he again petitioned Congress, this time for laws to protect American inventors. Out of this petition and subsequent active interest in the matter on the part of Stevens have sprung the present American patent system. In 1804 he constructed a propeller, a small open boat worked by steam, and his success was such that he built the Phenix which ran for six years on the Delaware river, a steamboat, which was completed but a very short time after Fulton had finished the Clermont. Fulton having obtained the exclusive right to the navigation of the Hudson, Mr. Stevens placed his boats on the Delaware and Connecticut. In 1812 he published a remarkable pamphlet urging the government to make experiments in railways traversed by steam carriages. The first steam ferry in the world was established by him in October 1811, connecting Hoboken with New York. His locomotive model (1826) was exhibited in operation and it has been claimed as the first locomotive run on a track in this country. His other inventions and improvements were many and various.

STEVENS, John Austin, American banker, son of Ebenezer Stevens (q.v.): b. New York, 22 Jan. 1795; d. there, 19 Oct. 1874. He was graduated at Yale University in 1813, and became his father's partner in the mercantile business in 1818. He was president of the New York Bank of Commerce in 1839–66. As chairman of a committee of bankers of New York, Boston and Philadelphia he greatly assisted the United States government in negotiating its loans during the Civil War, and he was frequently called into consultation by the Treasury Department. He was for many years secretary of the New York Chamber of Commerce and was one of the organizers of the New York Merchants' Exchange, of which he was the first president.

STEVENS, John Austin, American author: b. New York, 21 Jan. 1827; d. 16 June 1910. He was graduated at Harvard in 1848, when he entered commercial life, becoming secretary of the New York Chamber of Commerce (1862–68), and later, librarian of the New York Historical Society. He was founder of the Society of the Sons of the Revolution and the Loyal League, and was the founder and for many years editor of *The Magazine of American History* (1877–83). He wrote 'The Expedition of Lafayette against Arnold'; 'The Burgoyne Campaign'; 'Progress of New York in a Century'; 'The French in Rhode Island' and 'Life of Albert Gallatin,' 'The Valley of the Rio Grande'; 'Colonial Records of the New York Chamber of Commerce'; 'New York City.'

STEVENS, John F., American civil engineer and railroad official: b. Gardinier, Me., 25 April 1853. He was assistant engineer of the city of Minneapolis in 1874–76, and was afterward engaged in railroad engineering. In 1889 he became connected with the Great Northern Railroad and in 1902–03 he was its general manager. He was later connected with the Rock Island Railroad, and in 1904–05 he was second vice-president of the Pacific Railroad. He was appointed chief engineer of the Panama Canal in 1905, at the time when its construction policy was being determined, and for two months before he resigned, 1 April 1907, he was also chairman of the Isthmian Canal Commission. He was vice-president of the New York, New Haven and Hartford Railroad in 1907–09; and in 1909–11 he was president of the Spokane, Portland and Seattle, the Oregon Trunk and other western railroads.

STEVENS, John Leavitt, American writer and diplomat: b. Mount Vernon, Maine, 1 Aug. 1820; d. Augusta, Me., 8 Feb. 1895. He was ordained in 1844 in the Universalist ministry, but was obliged to give up the profession, in 1854, on account of ill-health. He became associated with James G. Blaine on *The Kennebec Journal* in 1855; went to the Maine legislature, 1865–68, and to the State senate, 1868–70. He was minister from the United States to Uruguay and Paraguay, 1870–73; and to Norway and Sweden, 1877–83. In 1889 he was sent as minister to the Hawaiian Islands, and in 1890 his rank was raised to that of Envoy Extraordinary and Minister Plenipotentiary. In 1893, having placed the islands, then in revolution, under the protection of the United States, Stevens was recalled by President Cleveland, who did not approve of his course; but he was exonerated by the Senate. He is the author of 'The History of Gustavus Adolphus' (1884) and a collaborator on 'Picturesque Hawaii' (1894).

STEVENS, Lillian M. N., American temperance worker; b. Dover, Me., 1 March 1844; d. Portland, Me., 6 April 1914. She was married to Michael Stevens of Portland, Me., in 1867. In 1874 she was one of the organizers of the Maine Women's Christian Temperance Union, was its treasurer in 1874–77 and its president the remainder of her life. She was also vice-president of the National Women's Christian Temperance Union in 1894–98 and its president from 1898 until her death. She was one of the lady managers of the Columbian Exposition in 1892–93.

STEVENS, Phineas, American soldier: b. Sudbury, Mass., 20 Feb. 1707; d. Chignecto, N. S., 6 Feb. 1756. At 16 he was carried captive by the Indians from Rutland, Mass., to Saint Francis, Canada and learned their mode of warfare. During King George's War he commanded Fort No. 4, now Charlestown, N. H., and he held this post successfully against the French and Indians till the close of the war. He was sent to Canada in 1749 to negotiate for exchange of prisoners and again in 1752. For journal of his trip in 1749 consult 'New Hampshire Historical Collections.' His travels in the American Colonies was edited by D. N. Mereness (New York 1916).

STEVENS, Robert Livingston, American inventor: b. Hoboken, N. J., 18 Oct. 1787; d. there, 20 April 1856. He was a son of John Stevens, inventor. He early became interested in steam navigation and made many improvements in the construction of vessels, among which was that of giving concave water lines to the hull. In 1813 he invented the beam-engine, percussion shells for smooth-bore guns, and in 1836 introduced the T-rail on the Camden and Amboy Railroad, of which he was president. He made many improvements in the marine engine.

STEVENS, Thaddeus, American statesman: b. Danville, Vt., 4 April 1792; d. Washington, D. C., 11 Aug. 1868. He was graduated at Dartmouth College in 1814; went to York, Pa., where he taught school. He was graduated in law, and began to practise in Gettysburg. In 1828 he joined the Whig party, and became active in politics. He worked with the party of anti-Masonry (q.v.), and took part in its Baltimore convention (September 1831). In 1833 and for several succeeding years he was a member of the Pennsylvania legislature, acted with the Whigs, and became distinguished through his opposition to slavery. At the State constitutional convention in 1836, to which he was a delegate, he advocated negro suffrage. During his legislative career he was engaged in fighting the party "machine," and in the end came off victorious. He was appointed a canal commissioner in 1838, and rendered important services to the State in developing its system of internal improvements. Removing to Lancaster, Pa., in 1842, he there engaged for six years in the practise of law. In 1848 and again in 1850 he was elected to Congress, where he strongly opposed the fugitive-slave law (see FUGITIVE-SLAVE LAWS), the Kansas-Nebraska Bill (q.v.), and other measures involving concessions to Southern interests. Again in 1858 he was elected to Congress, and became the acknowledged leader of the House, in which he remained as such until his death. Throughout the Civil War he was chairman of the Committee on Ways and Means, and afterward held the chairmanship of the Committee on Reconstruction. He reported from that committee the Reconstruction Act of 1867, having previously (1865) assisted in framing the Wade-Davis Reconstruction Bill. (See UNITED STATES). He was also chairman of the House committee which had charge of the impeachment of Andrew Johnson (q.v.). Stevens was a man of boundless energy and tenacity of will, with the intenseness of a zealot in the cause which he espoused; and in respect to slavery his radicalism outran that of all its other congressional opponents. Consult Callender, E. B., 'Thaddeus Stevens' (Boston 1882); McCall, 'Thaddeus Stevens' (in 'American Statesmen Series,' 1899); Woodburn, 'Thaddeus Stevens' (Indianapolis 1913).

STEVENS, Walter B., American journalist: b. Meriden, Conn., 25 July, 1848. Graduated University of Michigan, A.B., 1870; A.M., 1872; honorary degree of LL.D., from Washington University, Saint Louis, in 1908. From 1870 he was connected with Saint Louis newspapers; was Washington correspondent of the Saint Louis *Globe-Democrat*, 1884–1901; president of the Gridiron Club, 1895. As staff correspondent he traveled in Canada, Cuba, Mexico, Porto Rico, Jamaica, Panama and the United States writing in serial form letters over the signature «W.B.S.» on The New States, Convict Camps, In a Silver Country, Black Labor in the South, Signs of the Times, etc. He was secretary, director of exploitation and member of the superior jury, World's Fair of 1904; secretary of the National Prosperity Association in 1908; secretary of the Saint Louis Centennial Association in 1909; executive secretary of the Fourth American Peace Congress in 1913, secretary of the Saint Louis City Plan Commission, 1912–16. He has written ‘Through Texas,’ ‘The Ozark Uplift,’ ‘The Forest City,’ ‘A Trip to Panama,’ ‘Notes on Facsimiles of Robert Burns,’ ‘The Building of Saint Louis,’ ‘Saint Louis The Fourth City,’ ‘The Log of the Alton,’ ‘The Brown-Reynolds Duel,’ ‘Water Purification at Saint Louis,’ ‘Life of Samuel Morris Dodd,’ ‘Book of the Fourth American Peace Congress, Saint Louis,’ ‘Nights Wi' Burns,’ ‘Eleven Roads to Success,’ ‘Missouri the Centre State,’ ‘Halsey Cooley Ives,’ ‘Lincoln and Missouri,’ ‘Grant in Saint Louis.’

STEVENS, Walter Le Conte, American physicist: b. Gordon County, Ga., 17 June 1847. He was graduated at the University of South Carolina in 1868, and later studied at the universities of Strassburg, Berlin and Zürich. He was appointed professor of mathematics and physics at Packer Institute in 1882; was professor of physics at Rensselaer Polytechnic Institute in 1892–98; and since 1898 has been professor of physics at Washington and Lee University. He has specialized in physiological optics and acoustics, and is author of numerous scientific papers. He revised Steele's ‘Physics’ (1888).

STEVENS, William Arnold, American philologist and Baptist theologian: b. Granville, Ohio, 5 Feb. 1893; d. 2 Jan. 1910. He was graduated at Denison University in 1862 and later studied at the Rochester Theological Seminary and at the universities of Harvard, Leipzig and Berlin. He was professor of New Testament interpretation at the Rochester Theological Seminary in 1877–1910. Author of ‘Select Orations by Lysias’ (1876); ‘Commentary on the Epistles to the Thessalonians’ (1887); ‘A Harmony of the Gospels for Historical Study’ (1894; 3d ed., 1904); and joint author of ‘Outline Handbook of the Life of Christ’ (1892); ‘Life of the Apostle Paul’ (1894), etc.

STEVENS INSTITUTE OF TECHNOLOGY, is located at Castle Point, Hoboken, N. J. It was founded in 1870 by Edwin A. Stevens, who bequeathed about two acres of land, $150,000 for buildings, and $500,000 for an endowment for «an institution of learning.» The trustees decided that the new «institution» should be a college of mechanical engineering and in 1871 it was opened to students, being the first college course in America devoted to mechanical engineering and the first to give the degree of «Mechanical Engineer.» The founder, himself an engineer of achievement, was the son of John Stevens and the brother of Robert L. Stevens both famous in the early annals of American engineering. The Institute offers but one course of study for all students, requiring four years and leading to the degree of M.E. It has bestowed the honorary degrees of Doctor of Philosophy, Doctor of Science and Doctor of Engineering on prominent scientists and engineers. The subjects taught are basic in both science and economics and are designed to produce successful men in electrical, civil, chemical, hydraulic and other branches of practical engineering, as well as in mechanical engineering. In addition to the lecture and classroom subjects in science and business principles, the Institute maintains a foundry, blacksmith shop, machine shop, carpenter shop, drafting rooms, physical, chemical, electrical and experimental engineering laboratories in all of which there are organized courses which every student must pursue. During the entire four years the student is under the supervision of a physical director and is required to report twice a week for individual and class exercise. Henry Morton, Ph.D., LL.D., Sc.D., was the first president, being succeeded at his death in 1902 by Alexander C. Humphreys, M.E., Sc.D., LL.D. The Institute is governed by a board of 20 trustees, eleven of whom are Stevens graduates. Three of these serve as representatives of the Alumni Association for temporary periods of three years each. The principal increases in grounds, buildings and endowment have been: a total of $145,000 from Henry Morton for current uses, 1871–1902; grounds and buildings from Mrs. E. A. Stevens valued at $30,000, 1897; a laboratory of engineering and an endowment amounting to $350,000 from Andrew Carnegie, 1899–1911; land valued at $15,000 from Robert L. Stevens, 1905; $90,000 in the form of contributions from the Alumni toward the Morton Laboratory of Chemistry which was dedicated in 1906; a total of $26,000 from Dr. Edward Weston for extension of plant; $80,000 secured by President Humphreys from friends of the college, toward purchase of Castle Point property, 1910–1913; $1,385,000 from an intensive campaign for subscriptions in 1915, of which Andrew Carnegie gave $250,000, the Rockefeller Foundation, $250,000; William Hall Walker, $100,000, the remainder coming from alumni and friends. With these and other gifts the entire plant now includes about 23 acres situated on elevated ground on the bank of the Hudson River immediately overlooking New York City and harbor. It includes five large buildings used for instruction purposes, one of these being a large and well-equipped gymnasium constructed in 1916, from the subscription of William Hall Walker given expressly for this purpose. Stevens Castle, for several generations the home of the Stevens family, was secured in 1911 and is now used as a dormitory and social centre. The endowment funds in 1917 amounted to $1,625,000 and the entire plant was valued at about $2,800,000. The Institute offers 28 free scholarships of which 10 are available each year. Four of the scholarships are open to all, their presentation being in the control of the president of the college; the remainder are in the gift of specially designated schools, or of organizations that have provided funds for the endowment of scholarships. There is a special loan fund for students who need financial assistance. Six prizes, ranging from twenty dollars to fifty dollars, are offered each year for proficiency in chemistry, physics, general scholarship and accomplishment in student activity as measured by the upbuilding of character and its influence on student life.

STEVENS POINT, Wis., city, county-seat of Portage County; on the Wisconsin River, and on the Wisconsin Central and the Green Bay, Wisconsin and Saint Paul railroads; about 20 miles northeast of Grand Rapids and 100 miles north of Madison. It is the commercial and industrial section of the southern part of a rich pine district and has extensive lumbering interests. The river furnishes good water-power. The chief manufacturing establishments are several lumber mills, planing mills, foundries, flour mills, railroad shops, machine shops, furniture factories and important productions of self-rocking cradles and artificial flies for anglers. The educational institutions are private commercial schools, a high school, public and parish schools, a State normal school, a Polish convent and a public library. Two national banks have a combined capital of $150,000 and one State bank has a capital of $60,000. Pop. $12,000.

STEVENSON, stē-vĕn-sŏn, **Adlai Ewing,** American statesman: b. Christian County, Ky., 23 Oct. 1835; d. 1914. He was educated at Centre College, Danville, Ky., but without graduating removed to Bloomington, Ill., in 1852. He was admitted to the bar in 1857 and was master in chancery from 1860 to 1864. He took an active part in politics as a Democrat, and in 1875–77 and 1879–81 represented Illinois in the National House of Representatives. In 1885 was appointed first assistant postmaster-general but he antagonized the advocates of civil service reform by his wholesale removal, on political lines, of employees of the post office department; and after the renomination of Grover Cleveland in 1892 was chosen the candidate for the vice-presidency. The Democratic candidates were elected, and after the expiration of his term he was appointed by President McKinley a member of the American commission to visit Europe and endeavor to secure the adoption of international bimetalism. In 1908 he was Democratic candidate for the governship of Illinois.

STEVENSON, Andrew, American statesman: b. Virginia, 1784; d. Blenheim, Va., 25 June 1857. He studied law, attained a prominent position at the bar, in 1804 was elected to the house of delegates of Virginia, and after being a member for several sessions was chosen Speaker. In 1821 he was elected a representative in Congress and for 13 years held that office, for the last six of which he was Speaker of the House. He was minister to England from 1836 to 1841, and on his return became rector of the University of Virginia.

STEVENSON, Burton Egbert, American novelist, dramatist and anthologist: b. Chillicothe, Ohio, 9 Nov. 1872. He was educated at Princeton University, and entered newspaper work in 1893. Since 1899 he has been librarian of the Chillicothe Public Library. His novels are ‘At Odds with the Regent’ (1900); ‘A Soldier of Virginia’ (1901); ‘The Heritage’ (1902); ‘Tommy Remington's Battle’ (1902); ‘The Holladay Case’ (1903); ‘Cadets of Gascony’ (1904); ‘The Marathon Mystery’ (1904); ‘The Young Section Hand’ (1905); ‘The Girl with the Blue Sailor’ (1906); ‘The Young Train Dispatcher’ (1907); ‘That Affair at Elizabeth’ (1907); ‘The Quest for the Rose of Sharon’ (1909), ‘The Young Train-master’ (1909); ‘The Path of Honor’ (1910); ‘The Mystery of the Boule Cabinet’ (1912); ‘The Gloved Hand’ (1913); ‘The Destroyed’ (1913); ‘Little Comrade’ (1915). Mr. Stevenson's travels have resulted in two books, ‘The Spell of Holland’ (1911), and ‘The Charm of Ireland’ (1914). He is the editor of Theodore Winthrop's posthumous novel, ‘Mr. Waddy's Return,’ and of the Condensed Classics edition of Fielding's ‘Tom Jones.’ He is the editor and compiler of ‘Days and Deeds — Verse’ (1906); ‘Days and Deeds — Prose’ (1907); ‘Poems of American History’ (1908); and the author of ‘A Child's Guide to Biography’ (1909). He is also the compiler of the anthology ‘The Home Book of Verse’ (1912) and of the companion ‘Home Book of Verse for Young Folks’ (1915). He has done editorial work for various publications; is a contributor to the leading magazines; and the author of the play, ‘Little Comrade,’ a dramatization of his novel of the same name.

STEVENSON, Edward Luther, American cartographer and historian: b. Rozetta, Ill., 18 Oct. 1860. He was graduated at Franklin College, Indiana, in 1881, and afterward studied at the universities of Johns Hopkins, Jena, Halle and Heidelberg, taking his Ph.D. at Heidelberg in 1890. He was professor of history at Rutgers College in 1891–1911, and in 1910–15 he was secretary of the Hispanic Society of America. Since 1917 he has been lecturer on historical geography at the University of California. He is a leading authority on cartography, and in 1913 was made a Knight of the Royal Order of Isabelle the Catholic of Spain. Author of ‘Maps Illustrating the Early Exploration and Discovery of America, 1502–1530’ (1902–06); ‘The Marine World Chart of Nicolo de Canerio Januensis’ (1908); ‘Early Spanish Cartography of the New World’ (1909); ‘Willem Janszoon Blaeu, 1571–1638’ (1914); ‘Terrestrial and Celestial Globes’ (1917), etc.

STEVENSON, John James, geologist: b. New York, 10 Oct. 1841. He was graduated at New York University in 1863 and was professor of geology in his alma mater, 1871–1909 and since professor emeritus. He was United States geologist, 1873–74, 1878–80; was the geologist of the Pennsylvania geological survey, 1875–78, 1881–82; and was president of the New York Academy of Sciences, 1896–98. He published several geological treasures, among which are ‘Geology of a Portion of Colorado’ (1875); ‘Report on Greene and Washington Districts, Pa.’ (1876); ‘Geology of Bedford and Fulton Counties, Pa.’ (1882); ‘Monograph on Carboniferous of the Appalachian Basin’ (1903–07); ‘Formation of Coal Beds’ (1911–13), etc.

STEVENSON, Joseph, Scottish historian: b. Berwick-upon-Tweed, 27 Nov. 1806; d. London, 8 Feb. 1895. He studied at the University of Glasgow, and in 1831 was appointed to a position in the manuscript department of the British Museum, where in 1834 he became a sub-commissioner of the permanent records. He was reared in the Presbyterian Church, but in 1839 he was ordained in the Anglican Church. He was one of the editors of the Rolls Series of historical works under the title 'Chronicles and Memorials of Great Britain and Ireland' which the British government undertook at his suggestion in 1847. In 1863 he again changed his faith, entering the Roman Catholic Church, in which he was ordained priest in 1872. He was commissioned by the government to make a detailed examination of the Vatican archives, a work occupying four years and resulting in 13 volumes of transcripts now in the keeping of the Public Records Department. He edited numerous works for learned societies, as well as for the collections of the 'Church Historians of England,' and he was joint editor of 'Scottish National Memorials' (1890).

STEVENSON, Joseph Ross, American Presbyterian clergyman and educator: b. Ligonier, Pa., 1 March 1866. He was graduated at Washington and Jefferson College in 1886, at the McCormick Theological Seminary in 1889, later studied at the University of Berlin and was ordained in 1890. He was engaged as a pastor until 1894, when he became connected with the faculty of the McCormick Theological Seminary, where in 1897-1902 he occupied the chair of ecclesiastical history. He was in charge of the Fifth Avenue Presbyterian Church in 1902-09, and of Brown Memorial Church, Baltimore, in 1909-14. Since 1914 he has been president of the Princeton Theological Seminary. He was elected moderator of the Presbyterian General Assembly in 1915.

STEVENSON, Matilda Coxe, American ethnologist: b. San Augustine, Tex., 1855; d. 24 June 1915. Her maiden name was Evans and she was married to James Stevenson, an ethnologist, in 1872. From him she received instruction in ethnology, and for 13 years she was engaged with him in ethnological exploration in the Rocky Mountains. Left a widow in 1888 she was appointed to the staff of the Bureau of American Ethnology of the Smithsonian Institution, and was thereafter especially engaged in study of the Pueblo tribes of New Mexico and the Taos and Tewa Indians. Author of 'Zuñi and the Zuñians' (1881); 'Religious Life of the Zuñi Child' (1887); 'Zuñi Ancestral Gods and Masks' (1898); 'The Zuñi Indians; their Mythology, Esoteric Fraternities and Ceremonies' (1903), etc.

STEVENSON, Robert, Scottish engineer: b. Glasgow, 8 June 1772; d. Edinburgh, 12 July 1850. Having studied engineering, he was appointed engineer and superintendent of Scottish lighthouses. In 1843 he had constructed 23 lighthouses on the coast of Scotland. He was the originator of the intermittent or flash light now in general use. The famous Bell Rock Lighthouse, described in the Diary of Sir Walter Scott, was built by Stevenson in 1807-10 after overcoming tremendous difficulties. He was the grandfather of Robert Louis Stevenson.

STEVENSON, Robert Louis (baptized Robert Lewis Balfour), Scottish novelist, essayist, and poet: b. 8 Howard place, Edinburgh, 13 Nov. 1850; d. Vailima, island of Upolu, Samoa, 3 Dec. 1894. He was the only child of Thomas Stevenson, an eminent light-house engineer,— as his father, Robert Stevenson, had been before him,— and Margaret Isabella, daughter of the Rev. Lewis Balfour, of Colinton in Midlothian. He was a playful, imaginative child; was fond of being read to, and commenced to compose (by dictation) at the age of six. His health was infirm from the first; but he was tended and kept alive by a devoted nurse, Alison Cunningham, to whom he remained affectionately grateful throughout his life. His schooling was irregular and inconsecutive; and even while attending school he showed a truant disposition. On his many rambles, he always took a copy-book, in which he tried to fit into words his impressions of people and places, imitating the cadences of his favorite authors. In 1867 he entered Edinburgh University, and studied engineering with a view to following the family profession. He showed, however, little interest in this; though in 1871 he won a silver medal for a paper on light-house apparatus. The same year he gave up engineering, and began to study law. He was called to the bar in 1875; but immediately forsook the legal profession also, and turned his attention entirely to letters.

Acute nerve exhaustion and danger to the lungs forced him to spend the winter of 1873 at Mentone. In 1874 he joined the Savile Club in London, and soon made friends with many of the most prominent literary men of the day, including Sidney Colvin, William Ernest Henley, Edmund Gosse, Andrew Lang, Walter Pollock, Leslie Stephen, Cosmo Monkhouse, Sir Walter Simpson, George Meredith and Prof. Fleeming Jenkin. His social charm was irresistible, and he was noted for the brilliancy and ardor of his talk. Henley's sonnet, 'Apparition,' gives a vivid description of him at this period. He practised writing constantly. In April 1875, he made his first visit to the artist haunts of Fontainebleau, in company with his painter cousin, R. A. M. Stevenson. In 1876, in company with Simpson, he took the canoe trip from Antwerp to Grez, which he afterward narrated in his first book, 'An Inland Voyage' (1878); and in 1878 he went alone upon the tramping trip which resulted in 'Travels with a Donkey' (1879). These little books of travel stamped him already as a master of English prose style, though they were written with more elaborate mannerism than he showed in his maturer work. Meanwhile, beginning 1876, he contributed to the *Cornhill* and other magazines the critical essays later collected in 'Familiar Studies of Men and Books' (1882), and the bracing and vigorous papers on life and the living of it, collected in 'Virginibus Puerisque' (1881). As a critic he showed thorough study and sympathetic insight, and as a moralist he displayed a militant gaiety and bracing bravery of spirit. His first published stories were 'A Lodging for the Night' (1877); 'The Sire de Malétroit's Door' (1878), and 'Will o' the Mill' (1878). His first volume of fiction was 'New Arabian Nights,' which appeared serially June to October 1878. These early stories showed at once his romantic love for the poetry of circumstance, and his mastery of rapid and brilliant narrative.

Soon after the inland voyage of 1876, Stevenson met in France an American lady, Mrs. Fanny Van de Grift Osbourne, for whom he conceived almost immediately a devotion that changed the entire course of his life. Her domestic circumstances had been unhappy, and on her return home in 1878, she took steps to obtain a divorce from her husband. Learning her determination, Stevenson resolved to follow her, and started suddenly for California in August 1879. He undertook the journey against the remonstrances of his family and friends. He was very short of funds; and therefore crossed the ocean in the steerage, and traversed the continent in an emigrant train. The experiences of this double journey he afterward narrated in 'The Amateur Emigrant' and 'Across the Plains.' On board ship he wrote 'The Story of a Lie,' under stress of immediate need for money. The hardships that he genially endured resulted in a general breakdown of his health. From September to December 1879, he lived at Monterey and worked incessantly. In December 1879, he moved to San Francisco, where for three months he lived in a workman's lodging, and was reduced almost to the point of death by enforced frugality and excessive labor. Mrs. Osbourne nursed him back to life. She was now free from her former husband, and Stevenson married her in May 1880. Immediately afterward, in order to insure his recovery, the couple moved to a deserted mining camp in the California Coast Range. An account of their experiences here is given in the 'Silverado Squatters.'

In August 1880, Stevenson brought his wife to England, where she was enthusiastically welcomed by his parents and friends. During the next two years he spent his summers in Scotland and his winters, on account of his precarious health, at Davos Platz, in Switzerland, where he enjoyed the companionship of John Addington Symonds. At Davos he completed 'Treasure Island,' a stirring narrative for boys, both young and old, that made his fame as an artist in romance. It appeared serially in *Young Folks* from October 1881 to January 1882, and was published in book form in 1883. The author received £100 for the book rights of the story, and was delighted at the price, little knowing how the work was destined to endure. From 1882 to 1884 he lived in the south of France, partly at Marseilles and Nice, but chiefly at Hyères. In 1884 he returned to England and settled at Bournemouth, where he remained till 1887. His health was at its lowest ebb during this period. A great part of his time was spent necessarily in bed; often, because of his tendency to hemorrhages, he was forbidden to speak aloud. In spite of this handicap, he kept cheerfully at work, and produced, besides many minor stories of the highest merit, the graceful and urbane romance. 'Prince Otto' (1885), the thrilling and adventurous 'Kidnapped' (1886), and 'The Strange Case of Dr. Jekyll and Mr. Hyde' (1886), that terrible and searching tale of the good and bad in man. In 1885 he also published 'A Child's Garden of Verses,' a collection of poems showing such unsophisticated memory and intimate understanding of childhood as to make its author the poet laureate of the nursery. During the same period he composed four plays in collaboration with W. E. Henley; but his attempts in the dramatic form were never of great importance. In 1887 appeared 'The Merry Men and Other Tales,' a volume which collected some of his most artistic novelettes and short stories, among them being 'Markheim,' a grim tale of conscience and remorse; and also 'Memories and Portraits,' a collection of papers chiefly autobiographical.

The death of Stevenson's father in May 1887, severed the strongest tie which bound him to the old country; and weary of battling for health in an unpropitious climate, he accepted the advice of his physicians to try a complete change of surroundings. Accordingly, with his wife and mother, he sailed to America in August 1887. He spent the next winter at Saranac Lake, in the Adirondack Mountains. His main work that season was the preparation of 12 articles for *Scribner's Magazine*, which appeared one a month through 1888, and the composition of a large part of 'The Master of Ballantrae,' perhaps his most attractive romance. Among the *Scribner* papers were several of his greatest essays on literature and life,— for example, 'The Lantern Bearers,' 'Pulvis et Umbra' and 'A Christmas Sermon.' In June 1888, he crossed the continent to San Francisco; and being subsidised by large advance orders for travel letters and other literary work, sailed forth with his entire family on the schooner yacht *Casco* for a long voyage to the South Sea Islands. His first extensive stay was at Honolulu, 1889, where he completed 'The Master of Ballantrae' and also 'The Wrong Box,'— the latter in collaboration with his step-son, Mr. Lloyd Osbourne. Thence, in the schooner *Equator*, he proceeded to Samoa and Sydney. From Sydney, after voyaging to many islands on the steamer *Janet Nicoll*, he returned to Samoa, bought an estate named Vailima on a mountain slope above Apia in the island of Upolu, and determined to settle there for good. From 1891 to his death he lived at Vailima, building a great house and dwelling with a feudal dignity emulous of Scott's at Abbotsford. He was beloved by all the natives,— who called him "Tusitala," teller of tales,— took an active interest in Samoan affairs, and became, by the force of his engaging personality, a real power in the land. At Vailima he produced 'The Wrecker' and 'The Ebb Tide,' both in collaboration with Mr. Osbourne; a sequel to 'Kidnapped,' called 'Catriona, or David Balfour'; a collection of 'Island Nights Entertainments'; sundry writings about Samoan affairs; and three-quarters of a romance called 'St. Ives,' completed after his death by Mr. A. T. Quiller-Couch. In all of this work he was aided by his step-daughter, Mrs. Isobel Strong, who proved to be a devoted amanuensis. He also commenced 'Weir of Hermiston,' which gave promise of being by far the greatest of his novels. He labored on this book with feverish intensity until the very day of his death. The end came suddenly. With characteristic gaiety of spirit, he was making a salad on the veranda, when a blood-vessel burst in his brain. He lost consciousness immediately, and died within two hours. The Samoans bore his body to the summit of Vaea

Mountain, where he lies buried. See Treasure Island; Kidnapped; Dr. Jekyll and Mr. Hyde.

Bibliography.—All the material really necessary for a study of Stevenson is comprised in the Edinburgh and Thistle Editions, including the 'Life,' by Graham Balfour, and the 'Letters,' edited by Sidney Colvin (4 vols., New York 1911). Consult also the biography by Graham Balfour (2 vols., New York 1901); Simpson, E. B., 'Stevenson Originals' (New York 1912); Mrs. R. L. Stevenson, 'The Cruise of the Janet Nicoll among the South Sea Islands' (ib. 1914); Pinero, A. W., 'Robert Louis Stevenson as a Dramatist' (ib. 1914); James, Henry, in 'Notes on Novelists' (ib. 1914); and Hamilton, Clayton, 'On the Trail of Stevenson' (Garden City, N. Y., 1915); Rice, R. A., 'Stevenson, How to Know Him' (New York 1916).

Clayton Hamilton,
Sometime Tutor in English, Columbia University.

STEVENSON, Sara Yorke, American archæologist: b. Paris, France, 19 Feb. 1847. She was educated in Paris, lived in Mexico, and came to America in 1862, where in 1870 she was married to Cornelius Stevenson. She received the degree of Sc.D. from the University of Pennsylvania, the first degree ever conferred on a woman by that institution. In 1897 she went to Rome on a special mission for the departments of archæology and palæontology of the University of Pennsylvania, and in 1898 was sent to Egypt for the American Exploration Society, to make investigation in connection with archæological work in the Nile Valley. She was vice-president of the jury, for ethnology, Chicago Exposition, 1893; and has been assistant curator of the Pennsylvania Museum since 1908. She has been various times president of the Civic Club of Philadelphia and was the first woman lecturer on the Harvard Calendar (1894). Since 1908 she has been literary editor of the *Public Ledger* of Philadelphia. She has published 'Maximilian in Mexico' and 'The Book of the Dead.'

STEWARD, Sir William Jukes, Australian statesman and author: b. Reading, England, 1841; d. 2 Nov. 1912. He went to New Zealand in 1862 and a few years later entered journalism and became successively editor of the *North Ortage Times, Wainmate Times* and the *Ashburton Mail* and *Guardian*. Elected to the house of Representatives in 1870 he held his seat until his death and during this long tenure of office had many important commissions and offices in connection with the legislative body, among that of speaker (1891–93). He was knighted in 1902. Among his published works are 'Carmina Varia' (1867); 'The Vision of Aorangi and Other Poems' (1906); 'Parliamentary Procedure in New Zealand' (1906). A great deal of his most interesting work is in the files of magazines and newspapers.

STEWARD (Anglo-Saxon, *stig,* cattle-pen, and *weard,* guard) in common usage, a head servant who attends to domestic matters in a house, club, hotel or other establishment. (1) On shipboard an officer whose duty it is to distribute provisions to the officers and men. In passenger ships, a man who superintends the distribution of provisions and liquors, waits at table, etc. (2) A fiscal agent of certain bodies; as, the recording steward of a congregation of Methodists. (3) The Lord High Steward of England was one of the ancient officers of state, the greatest under the crown. A lord high steward is now made only for particular occasions, such as a coronation or the trial of a peer. (4) The Steward of the Household, an officer of the English royal household, who is head of the court called the Board of Green Cloth, which has the supervision of the household expenses and accounts. He selects the officers and servants of the household and he appoints the royal tradesmen. This office is of very ancient origin and was hereditary, though not always in the same line, until 1319, when Henry IV merged it with the crown.

STEWART, stū'art, **Alexander P.,** Amercan military officer: b. Rogersville, Tenn., 2 Oct. 1821; d. Biloxi, Miss., 30 Aug. 1908. He was graduated from the Military Academy in 1842 and after serving in the artillery for three years resigned from the army. When the Civil War came Stewart was appointed a major of artillery by Governor Harris of Tennessee. His promotion was rapid. He was made a major-general on 2 June 1863 and lieutenant-general on 23 June 1864, almost a year before the close of the war. In 1868 he accepted the chair of professor of mathematics in the University of Mississippi, and from 1874 to 1886 was chancellor.

STEWART, Alexander Turney, American merchant: b. Belfast, Ireland, 12 Oct. 1803; d. 10 April 1876. He came to the United States in 1823 and engaged in teaching. In 1825 he founded in New York, a dry-goods business which gradually expanded into one of the largest mercantile concerns in the world. He was at one time considered the wealthiest man in the United States and was a giver of large sums of money to various charitable institutions, and was active in many philanthropic undertakings. Before his death the business of which he was head had branches and agencies in the principal cities of Europe and several factories and mills at home. He was buried in Saint Mark's churchyard, from which his remains were stolen on 7 Nov. 1878. They were afterward recovered and deposited in the mausoleum of the Cathedral of the Incarnation, erected by Mrs. Stewart in memory of her husband at Garden City, Long Island.

STEWART, Alvan, American lawyer and reformer: b. South Granville, Washington County, N. Y., 1 Sept. 1790; d. New York, 1 May 1849. He moved with his parents to Vermont, where in 1809 he entered Burlington College. He spent some time in Canada in 1811–12, but in the latter year returned to college. During the War of 1812 he again went to Canada and was held as a prisoner. On his return to the United States he studied law and began the practice of his profession at Cherry Valley, N. Y., where he rapidly attained success. In 1832 he moved to Utica and continued his practice, but gave a large share of his time and attention to the temperance and anti-slavery causes. His first anti-slavery speech was delivered in 1835; in 1837 he called and organized an anti-slavery convention at Utica, which was, however, soon dispersed by mob violence. He was the leader in New York State in forming an independent political party to promote the abolition of slavery, and was that party's candidate for governor. Among his most famous speeches are those delivered before the New Jersey Supreme Court to establish the unconstitutionality of slavery in the State under the Constitution of 1844, and one delivered in 1837 to prove that Congress could constitutionally abolish slavery. His speeches were edited by L. R. Marsh and published under the title, ‘Writings and Speeches of A. Stewart on Slavery.’

STEWART, Balfour, Scottish physicist: b. Edinburgh, 1 Nov. 1828; d. near Drogheda, 18 Dec. 1887. He was educated at Dundee and later at the University of Edinburgh. In 1859 he was appointed director of the observatory at Kew and in 1870 professor of physics, Owens College, Manchester. He is best known by his investigations into the absorption and radiation of heat and his remarkable meteorological studies, especially those undertaken in collaboration with De la Rue and Loewy on the physical constitution of the sun, and with Tait on the generation of heat in a vacuum. He devoted most of his labors to the study of terrestrial magnetism. His main discovery on the subject of heat constituted a remarkable extension of what is known as Prévost's «Law of Exchanges,» and he established the fact that radiation is not a surface phenomenon, but takes place throughout the interior of the radiating body, and that the radiative and absorptive powers of a body must be equal. He published ‘Elementary Treatise on Heat’ (1866); ‘Elementary Physics’ (1870); ‘Physics’ (1872); ‘The Conservation of Energy’ (1872); ‘Practical Physics’ (1885); ‘Terrestrial Magnetism,’ in the ‘Encyclopedia Britannica’ (9th ed., etc.). Consult ‘Men and Women of the Time’ (12 ed.).

STEWART, Bertrand, English army captain: d. August 1914 in action, reported to be the first man killed in the British expeditionary force in France. Though a lawyer by profession, he had held a commission in a Yeomanry regiment for many years, had served through the South African war as a trooper and was attached to the staff of Sir John French at the time of his death. Stewart was arrested in Bremen, Germany, on 7 Aug. 1911 on a charge of espionage. He was accused of visiting various towns and islands (where he had never been) and of attempting to secure secrets concerning German military and naval defences and the North Sea dockyards. He was made the subject of a bitter press campaign in Germany and described as «the gentleman spy,» ferretting out secrets to the advantage of «our adversary,» as England was openly designated. He was tried in camera and on the evidence of only one witness was sentenced to three and a half years' imprisonment in a fortress 3 Feb. 1912. He was released in May 1913 as an act of clemency on King George's visit to Berlin.

STEWART, Charles, American naval officer: b. Philadelphia, Pa., 28 July 1778; d. Bordentown, N. J., 7 Nov. 1869. Shipping on a merchant ship at the age of 13, he eventually became captain. In 1798 he entered the navy as a lieutenant on board the frigate *United States* and served on this vessel among the West Indies and against French privateers. In 1800 he returned to the marine service and was captain of several schooners. Later he commanded privateers. In this latter capacity he captured the French vessels *Deux Amis* and *Diane*. In 1804 he joined the Mediterranean squadron, where he took command of the *Siren* in operations against Tripoli. On his return to the United States in 1806 he was promoted to the rank of captain. In 1813 he commanded the *Constitution* in a cruise to the Guiana coast and the Windward Islands, which resulted in the capture of the British schooner *Piston* and a number of merchant vessels. In 1815 he made a second cruise in the same vessel and captured two large British ships, the *Cyane* and the *Levant*, but he was later defeated by the British and lost the *Levant* to them. In 1816–20 he commanded a squadron in the Mediterranean and from 1821–23 he had command of a Pacific squadron. He was also in command of the home squadron (1842–43). In 1857 he was placed on the retired list, but two years later took charge of the Philadelphia Navy Yard, which office he held for three years, when he was retired as rear-admiral.

STEWART, Dugald, Scottish philosopher: b. Edinburg, 22 Nov. 1753; d. there, 11 June 1828. He was the son of Matthew Stewart, who for 25 years was professor of mathematics at Edinburgh University, and there young Dugald studied from 1765 to 1769, devoting himself to mathematics and philosophy. In the latter subject his teacher was Adam Ferguson. In 1771 Stewart went to Glasgow, partly to prepare himself as a candidate for one of the Snell scholarships at Oxford, and partly to attend the lectures of Thomas Reid, who came to exercise a profound influence on the young student. In 1772 he was called upon by his father, whose health was failing, to teach the mathematical classes in the University of Edinburg. In 1775 he was elected joint professor and acted in that capacity till 1785. During Ferguson's absence on a political mission in America in 1778–79, Stewart also had charge of the courses in philosophy, and upon the resignation of Ferguson in 1785 was chosen to succeed him and continued in the active duties of his class for 25 years. His field embraced a wide array of subjects: psychology, logic, metaphysics, ethics, natural theology, the principles of taste, politics, and last of all, political economy. In 1792 appeared the first volume of the ‘Elements of the Human Mind,’ followed in 1793 by the ‘Outlines of Moral Philosophy.’ In the same year he read before the Royal Society of Edinburgh his ‘Account of the Life and Writings of Adam Smith’; in 1796 came the ‘Account of the Life and Writings of Principal Robertson,’ and in 1802 the ‘Account of the Life and Writings of Dr. Reid.’ In 1806 he received a sinecure office worth £300 a year. The death of his second son in 1809 proved a severe blow for his health, otherwise indifferent, and he was unable to conduct his lectures during the following session. Thomas Brown was appointed as conjoint professor, and Stewart passed the rest of his life in retirement. In 1810 he published his ‘Philosophical Essays’; in 1814 the second volume of the ‘Elements of, the Human Mind›; in 1815 the first part and in 1821 the second part of ‹A Dissertation on the Progress of Metaphysical, Ethical and Political Philosophy since the Revival of Learning›; in 1827 the third volume of the ‹Elements›; and in 1828, a few weeks before his death, the ‹Philosophy of the Active and Moral Powers.› Stewart has little claim to be considered an original thinker, and his chief importance rests in the success which attended his attempt to expound the philosophy of Thomas Reid. From the latter he differed chiefly in his more sympathetic attitude toward the Cartesian philosophy, and in certain principles of psychology, notably those connected with the subject of association. A gifted orator and possessed of an extremely attractive personality, Stewart attained very great popularity as a lecturer and he was successful in implanting in the minds of his hearers a profound respect for the value of philosophic thought and the standards of a lofty morality. His works, in 11 volumes, appeared in 1854–58 and included the ‹Life,› by John Veitch. Consult also McCosh, ‹Scottish Philosophy› (1875); Stephen, ‹English Thought in the 18th Century.›

STEWART, George, Canadian journalist: b. New York, 26 Nov. 1848; d. 1906. He early removed with his parents to the province of New Brunswick, Canada, and was educated there. He edited and published *Stewart's Literary Quarterly Magazine* in 1867–72, and was afterward engaged in newspaper work, serving as editor of the Quebec *Daily Chronicle* in 1879–96. Author of ‹Canada Under the Administration of the Earl of Dufferin› (1878); ‹Emerson the Thinker› (1879); ‹Essays from Reviews› (1892–93), etc.

STEWART, George Black, American Presbyterian clergyman and educator: b. Columbus, Ohio, 28 Feb. 1854. He was graduated at Princeton University in 1876, later studied at the McCormick Theological Seminary and was graduated at the Auburn Seminary in 1879. He was ordained in 1879 and held pastorates until 1899, when he became president of Auburn Seminary. He also holds the chair of practical theology there. He was founder of the Pennsylvania Chautauqua, of which he was president for five years. He is a contributor to religious periodicals, is editor of the Auburn Seminary *Record,* and is author of ‹Life of Jesus for Juniors› (1896); ‹A Study of the Life of Jesus› (1907); ‹Efficiency Tests for Pastors and Churches› (1915), etc.

STEWART, James, Canadian physician and educator: b. Osgoode, Ontario, 1846; d. 1906. He was graduated in medicine at McGill University in 1869 and afterward engaged in practice as a physician. He was professor of materia medica and therapeutics at McGill University in 1883–91, held the chair of clinical medicine there in 1891–93 and from 1893 was also professor of medicine. He was president of the Association of American Physicians in 1903. He wrote extensively on neurology, and was for many years one of the editors of the Montreal *Medical Journal.*

STEWART, Julius, American artist: b. Philadelphia, Pa., 6 Sept. 1855. He studied under Gérôme and Madrazo at Paris, and lived there the greater share of his life. He is known as a figure and genre painter. His style is decidedly French in finish, but his characterizations of American types is excellent, particularly his studies of the American colony in Paris. He was a member of the executive and advisory committee of the Saint Louis Exposition in 1904. He was awarded gold medals at Berlin in 1891 and 1895 and at Munich in 1897 and 1901. He was elected a chevalier of the Legion of Honor in 1901. His ‹Hunt Ball› is in the Essex Club, Newark, N. J.

STEWART, Matthew, Scottish mathematician: b. Rothesay, 1717; d. Edinburgh, 23 Jan. 1785. He studied at the University of Glasgow, and in 1746 published his ‹General Theorems of Considerable Use in the Higher Parts of Mathematics.› In 1761 he published ‹Tracts Physical and Mathematical,› and in 1763 ‹Propositiones Geometricæ More Veterum Demonstratæ.›

STEWART, Robert, marquis of Londonderry. See CASTLEREAGH.

STEWART, William Rhinelander, American humanitarian: b. New York, 3 Dec. 1852. He was graduated at the Columbia Law School in 1873, and engaged in law practice, but abandoned it in favor of his work as executor and trustee and for philanthropic work. He became in 1908 the president of the Rhinelander Real Estate Company. He was commissioner on the New York State Board of Charities from 1882, was its president in 1894–1900 and has occupied that office since 1904. He was president of the 25th National Conference of Charities and Correction in 1898; in 1900 he organized the New York Board of Charities and Correction, serving as its president in 1903, and in 1910 he organized a similar conference for New York City. In 1889 he organized the committee that erected Washington Arch in Washington square, New York, and served as its treasurer. He was one of the committee of 70 organized in 1894 for the purpose of defeating Tammany Hall. Author of ‹The Philanthropic Work of Josephine Shaw Lowell› (1911).

STEWART ISLAND, New Zealand, the smallest and southernmost of the three main islands composing New Zealand (q.v.). It is separated by Foveaux Strait from the southern extremity of South Island. Its area, together with the neighboring islets, is 665 square miles, and its population about 300.

STEWARTIA, a genus of the tea family, which contains ornamental shrubs and trees, found only in eastern America and eastern Asia. They have simple, membranous, deciduous leaves, which turn to brilliant autumnal coloring, and solitary, axillary flowers. These blossoms are large and showy, cup-shaped and like camellias. They have usually five petals and numerous stamens; the fruits are capsules, somewhat woody and contain lenticular seeds, sometimes winged. The two American white-flowered species, from the Southern States are *S. malachodendron,* bearing the largest flowers of the genus, and *S. pentagyna,* flowering in late spring and summer. These are sometimes cultivated, but *S. pseudo-camellia* is more widely known. In its original habitat, mountainous Japan, this species is a tall tree, with smooth, bright-red bark, flaking off in thin, large pieces. It has handsome, elliptical, dark-green leaves, not troubled by insects, and creamy-petaled flowers, with wavy edges, purple filaments and orange stamens. Like the *S. pentagyna*, it is hardy as far north as Massachusetts.

STEYER, stī'ĕr, or **STEYR**, stir, a city in Austria, at the junction of the Steyer with the Enns, 19 miles southeast of Linz. The town proper has two suburbs connected by bridges, and there are three public squares, one of which contains beautiful fountains. The buildings are typically Italian: the parish church is modeled on Saint Stephen's of Vienna; the town-hall is embellished by a graceful tower; the Castle of Lemberg (10th century) stands upon a rocky height overlooking the rivers. There are several monuments, a grammar school, technical and industrial schools and museum. Steyer is one of the most important manufacturing cities of Austria and very wealthy. The factories for iron and steel, paper, calico, woolens, leather, cutlery, hosiery, bell-founding, dyeing, small-arms, and bicycles are among the most important of the country. The historical interest of the town centres in the treaty of peace concluded there 25 Dec. 1800 between Austria and France. Pop. 18,000.

STEYN, Marthinus Theunis, ex-president of the Orange Free State, South Africa: b. 2 Oct. 1857; d. 28 Nov. 1916. Of Dutch (Boer) descent, his mother was a daughter of Wessels, one of the leaders of the Great Trek in 1836. He studied law in England, was called to the bar and returned to South Africa to practise in Bloemfontein. He became a judge before he was 40, and was elected President of the Orange Free State in 1895. In the South African War of 1899 he threw in his lot with President Kruger. Both republics were annexed by Great Britain as a result of the war and were federated under the Union of South Africa in 1910. Though he subscribed to the Constitution, Steyn was strongly suspected of favoring the rebellion of 1915. See BEYERS; ORANGE FREE STATE, PROVINCE OF THE; WAR, EUROPEAN.

STIBICONITE, a mineral consisting of hydrous-oxide of antimony, $Sb_2O_4.H_2O$. It contains 74.05 per cent of antimony and is an important ore in Nevada and California.

STIBNITE, ANTIMONITE, or **ANTIMONY-GLANCE**, the only important ore of antimony. It crystallizes in the orthorhombic system and forms not only in acicular crystals often radially grouped, but also, in Japan, in magnificent groups of large crystals, prismatic and deeply striated vertically, which are undoubtedly among the finest of mineral specimens. The crystals are often twisted, while angular bends, due to gliding planes, are very common. Massive, granular and columnar forms also occur. Brachypinacoidal cleavage is highly perfect. Though flexible, even when in large, stout crystals, and slightly sectile, it seems very brittle because of its easy cleavage. It is very soft, hardness 2; specific gravity 4.6; lustre metallic, splendent; color and streak lead-gray, becoming black and often iridescent on exposure to light. Chemically it is antimony trisulphide, Sb_2S_3. It fuses even in large pieces in the flame of a candle and is number one in the scale of fusibility. It occurs in many localities throughout central Europe, in England, China, Mexico, New Brunswick, and in the United States in Arkansas, Utah, California and elsewhere. See also ANTIMONY.

STICK-INSECTS. See WALKING-STICK.

STICKIT MINISTER, The, and Some Common Men, a collection of short stories by Samuel Rutherford Crockett (q.v.), published in 1893.

STICKLEBACK, a small fish of the family *Gasterosteidæ*, order *Hemibranchii*, in which the rays of the first dorsal fin form a series of detached spines. The body is elongated and compressed and tapers behind to a narrow caudal peduncle. Teeth exist in both jaws, but are absent from the tongue and palate. The premaxillary is protractile. The sides of the body may be covered with vertical bony plates, while the other parts are destitute of any scaly covering. These fishes inhabit the rivers and brackish waters of temperate climates of the northern hemisphere. The brook stickleback (*G. bispinosus*), very common on the New England and New Jersey coasts and sometimes in fresh water, is a voracious little fish, swimming eagerly after bait of all kinds, and not at all disturbed by noises and acts which would infallibly frighten away most other fishes. It is highly pugnacious, especially at the breeding season. In its reproductive habits it evinces many most interesting features, constructing a nest and attending its young with care and affection. The nest is the size of a large hickory-nut and is composed of vegetable matters, pieces of straw, sticks and the like, bound together with a silky fibre secreted by an organ closely connected with the kidneys of the male. In the top of the nest a small pit is formed in which the eggs are deposited. These are about the size of poppy seeds, and are bright-yellow. Over this nest and its contained ova the fishes watch with the most jealous care, the male taking upon himself almost the entire duty of nidification, as well as of tending the young after hatching. The genera *Eucalia, Pygosteus* and *Apeltes* are all represented in the salt or fresh waters of the United States, where are found seven species of these interesting little fishes, each exhibiting individual peculiarities in appearance and habits. Consult Gill, 'Standard Natural History,' Vol. III (Boston 1885), and Ryder, 'Bulletin United States Fish Commission' (Washington 1881).

STIEGLITZ, Julius Oscar, American chemist: b. Hoboken, N. J., 26 May 1867. He was graduated at the Realgymnasium, Carlsruhe, Germany, in 1886; took his Ph.D. at the University of Berlin in 1889; and after his return to the United States studied at Clark University. He was connected with the faculty at the University of Chicago from 1892, became professor of analytical chemistry there in 1905, director of the laboratories in 1912, and since 1915 has been chairman of the chemical department. He was Hitchcock lecturer at the University of California in 1909, and became a member of the National Academy of Sciences in 1911. Author of papers on molecular rearrangements, carbamid bases, imido ethers and related subjects and of 'The Elements of Qualitative Chemical Analysis' (2 vols., 1911–12).

STIGAND, stĭg'and, **William,** English clergyman: b. 1002; d. 1064. He enjoyed great favor with King Edward, who in 1044 made him royal chaplain and bishop of Elmham or of the East Angles. Eight years later. the bishop mediated sucessfully in the interests of peace between the king and Earl Godwin, and was awarded with the archbishopric of Canterbury. Stigand received the pallium from Pope Benedict X. On the death of Harold, Stigand gave his vote for Edgar Atheling to be king, and for this reason, and because he was a firm friend of the House of Godwin, William the Conqueror distrusted him, and induced the Pope to send a commission of cardinals, who deprived him of his dignities and sentenced him to perpetual imprisonment. But Stigand died shortly afterward in Winchester, starved to death, it is said.

STIGMA, plural, stigmas, or stigmata (Greek *stigma,* mark, puncture, brand), a mark made with a red-hot iron; a brand impressed on slaves and others. The original Greek signification of the word has received many secondary meanings. Owing to its association with the branding of slaves, stigma has come to have the signification of a mark of infamy, a slur attached to any one on account of evil conduct. n anatomy stigma bears a meaning closer to the original signification of the word which was to puncture with a sharp pointed instrument. This sense is closely related to that of the English verb “to stick,” meaning to pierce, puncture or stab (with a pen or other pointed weapon). The expression “to stick one with a stick” conveys the meaning and shows the derivation of the English word, which is related to the English to sting, and the German *stechen,* to prick, pierce, sting thrust and stab. These being the equivalents of stigma in the English language, the Greek word came to have, in English, a more or less popular usage, only one of its significations, and that metaphorical, being derived from its association with slaves and outcasts, the official marks on whom came to be symbolical with social and moral degradation.

But science has gone back to the original sense of the Greek word and has given us numerous scientific terms in modern English, derived from the Greek or from its Latin derivative. In anatomy and zoology stigma is used in the sense of a mark, point or noticeable place, as for example a naevus, a birth-mark. The place on the surface of an ovary where there is a rupture of a mature Graafian follicle is termed a stigma. The word also signifies a chitinous mark on the anterior margin of the forewings of numerous insects. It is the term used to designate the interior orifice of a trachea, a spot of pigment in protozoa, one of the pores of the segmental organs; a ciliated opening connecting the cavity of the pharynx with that of the artificial canal. Any mark on the skin which bleeds periodically or even at irregular intervals is also termed a stigma. None of these uses of the term departs from the root meaning of the word, which, as we have seen, was to puncture or prick, with the substantive sense of the thing punctured or pricked.

In botany the stigma is a part of the style, or in the absence of the latter, of the surface of the ovary, which receives the pollen.

Stigma was used in Greek grammar as a signature which is still used sometimes for “st.” It also designated the number six.

STIGMATA, the Greek plural form of stigma, is used in various collective significations. Anatomical stigmata, for instance, comprises irregularities or malformations of various parts of the anatomy, among them being those of the face, the skull-cap, palate, teeth, tongue, lips, nose, ears, limbs, fingers, thorax and, in general, any part of the human anatomy. The presence of less or more than four fingers on one human hand would be stigma, as would be the dwarfing or over growth of the frame of man or animal. Abnormal conditions of the skin, hair and limbs are also characterized as stigmata. Often these persistent stigmata are used as signs by which to judge abnormal conditions or physical, mental or moral degeneracy in an individual. These abnormalities have been classified by Peterson as belonging to (1) motor functions; (2) sensory functions; (3) speech; (4) genitro-urinary function; (5) instinct or appetite; (6) diminished resistence to diseases and external influences; (7) delayed development of puberty.

Under the head of **psychical stigmata** are classified all kinds of irregular functions of the mind from simple feeble-mindedness, eccentricity, moral delinquency and sexual perversion to idiocy and embecility. In this section stigmata have been divided and subdivided by scientists and specialists into a large number of classes and a vast number of interesting and important experiments have been made to show the relation of each separate abnormality to the normal individual. Frederick Peterson, an authority on the subject of deformities, for example, found only 10 per cent of abnormal palates among persons apparently otherwise normal and 40 per cent among feeble-minded persons. Another investigator found 35 per cent of abnormal palates among people subjected to general paralysis; 70 per cent among hysterical insane; 76 per cent in epileptics; 80 per cent among hopelessly insane; and 82 per cent among idiots. But apparently the investigations did not show whether the diseases were affected by the abnormalities or the latter the direct or indirect result of the diseases. See Eugenics; **Herredity**; Psychology of the Abnormal.

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gelische Kirchenzeitung' (pp. 183, 345, Berlin 1875); Steill, 'Ephemerides dominicano sacræ' (Dillingen 1692); Thiepolus, 'De passione Christi'; Thorluck, 'Vermischte Schriften' (Hamburg 1839).

STIGMATIZATION, derived from the Greek word *stigma*, a puncture, the name applied by Roman Catholic writers to the impression on certain individuals of the "stigmata," or marks of the wounds which Christ suffered during the course of His Passion. In the early days many Christians branded the name of Christ on their foreheads, and various voluntary mutilations for Christ's sake were practised by enthusiasts. The stigmata comprise not only the wounds of the hands and feet, and that of the side, received in the crucifixion, but also those impressed by the crown of thorns and by the scourging. The most remarkable example of stigmatization is that narrated of Saint Francis of Assisi and occurring in 1224, on the mountain of Alverno. Being absorbed in rapturous contemplation of the Passion of Christ, he saw a seraph with six shining wings, blazing with fire, and having between his wings the figure of a man crucified, descend from heaven and approach him, so as to be almost in contact. After a time the vision disappeared, leaving the soul of Francis filled with reverence and awe. And now he became aware that in hands, feet and side he had received externally the marks of cruicifixion. These mysterious marks continued during the two years until his death, and are declared by the saint's biographers to have been seen by many eye-witnesses, including Pope Alexander IV.

The Dominicans openly disputed the fact, but at length made the same claim for Catharine of Sienna, whose stigmata were explained as at her own request made invisible to others. The Franciscans appealed to Sixtus IV, and that pope, himself a Franciscan, forbade representations of Saint Catherine to be made with the stigmata. Still the fact is recorded in the breviary office, and Benedict XIII granted the Dominicans a special feast in commemoration of it. Many others, especially women, are enumerated as having received all or some of the stigmata. Among these is Saint Veronica Giuliani, who is said to have received in 1694 first the marks of the crown of thorns, and afterward those of the crucifixion. More recent cases are those of Anna Katherina Emmerich (1774–1824), who became a nun at Agnetenberg; "L'Ecstatica" Maria von Morl of Caldaro (1839); Louis Lateau (1850–83, in 1868), whose stigmata were stated to bleed every Friday; and Mrs. Girling (1827–86, about Christmas 1864), of the New Forest Shaker community. Dr. Imbert-Gourbeyre, in his work 'Les Stigmatisées' (1873), enumerates 145 persons, of whom but 20 were men, as having received the stigmata, and of these 80 lived before the 17th century. By 1894 he had collected 321 examples of stigmatization. Apart altogether from the question of the value of the evidence offered, we may reasonably conclude that some kind of stigmatization is a pathological condition of occasional occurrence. The Roman Catholic Church is extremely cautious in giving credence to cases of stigmatization as genuinely supernatural and Theodor Schwann, a professed Catholic professor at Louvain and a noted biologist, who carefully looked into the subject, refused to admit for stigmatization other than a perfectly natural character. See STIGMATA.

STIKINE, stĭk-ēn', **STAKHIN**, a Tlingit tribe of the Koluschan linguistic stock of North American Indians, about the mouth of Stikine River, southern coast of Alaska. They are divided into the Wolf and the Raven clans. In 1880 they numbered 317 in eight villages, but by 1890 they had diminished to 255.

STILBENE DYESTUFFS. See COAL-TAR COLORS.

STILBITE, one of the commonest of the zeolite family of minerals. Though crystallizing in the monoclinic system, its crystals simulate rhombic forms on account of their twinning which is uniformly present and which is revealed by polarized light under the microscope by the division into sectors whose extinction angles are 10°. These twin crystals are often grouped into the curious sheaf-like bundles so characteristic of the species. Clinopinacoidal cleavage is perfect; fracture uneven; brittle; hardness 3.5 to 4; specific gravity 2.2; lustre vitreous, pearly on the clinopinacoid; color usually white or yellowish, though not infrequently brownish to brick-red; transparent or translucent. Essentially a hydrous silicate of aluminum and calcium, generally with a little soda. Before the blowpipe it acts like scolecite (q.v.). It mostly occurs in cavities in trap rocks. Many localities have yielded fine specimens, among the most important being Poona, India; Iceland; Faröe Islands; Nova Scotia; Paterson and Upper Montclair in New Jersey. Sphæro-stilbite and puflerite are globular varieties.

STILES, stīlz, **Charles Wardell**, American zoologist: b. Spring Valley, N. Y., 15 May 1867. He was educated at Wesleyan University, Conn., 1885–86; Collège de France, 1886–87; Berlin University, 1887–89; Leipzig University, 1889–90; Trieste Zoological station, 1891; Pasteur Institute and Collège de France, 1891. He was zoologist, 1891–1902, and has been consulting zoologist since 1902, in the bureau of animal industry, United States Department of Agriculture. He has been professor of zoology in the United States Public Health Service since August 1902; professor of medical zoology at Georgetown University 1892–06; at Johns Hopkins University since 1897; and United States Navy Medical School since 1902; and was a special lecturer on that subject at the Army Medical School, 1894–1902; scientific secretary of Rockefeller Sanitary Commission, 1909–14. He has held other offices as consultant with national and private scientific institutions, has represented the United States government at several International Zoological Congresses, and was detailed as agricultural and scientific attaché to the United States Embassy, Berlin, 1898–99; secretary of International Commission on zoological nomenclature since 1896. His publications, chiefly on medical zoology and sanitation include 'A Revision of the Adult Cestodes of Cattle, Sheep and Allied Animals' (1893); 'Tapeworms of Poultry' (1896); 'Internal Parasites of the Fur Seal' (1899); 'The Cattle Ticks of the United States' (1902); 'Report on Hook Worm Disease in the United States' (1903); 'Index-Catalog of Medical and

Veterinary Zoology,› 7 vols., etc. Outside of scientific circles he is known chiefly because of his medical studies among the tenant whites of the South, upon the medical side of the negro problem and child labor, and because of his connection with the hookworm problem.

STILES, Ezra, American clergyman and college president: b. North Haven, Conn., 15 Dec. 1725; d. New Haven, Conn., 12 May 1795. He was graduated from Yale in 1746, and was a tutor there 1749–55. Dr. Franklin having sent an electrical apparatus to Yale, Stiles entered with great zeal upon this then new field of philosophical investigation, and performed the first electrical experiments ever made in New England. At the time he was pursuing the study of theology; was licensed, and commenced his ecclesiastical work in June 1749. In April 1750 he visited the Housatonic tribe of Indians at Stockbridge. He then studied law, in 1753 was admitted to the bar, and practised at New Haven for the two following years. In 1775 he became pastor of the Second Church in Newport, R. I., and during his residence there found time for literary and scientific investigations, corresponding with learned men in almost every part of the world. His congregation at Newport being entirely broken up by the British occupation of the place, in May 1777 he removed to Portsmouth, N. H., to become pastor of the North Church. In September following he was elected president of Yale and shortly after professor of ecclesiastical history in connection with the presidency; and in June 1778 he entered on his official duties. After 1780 he discharged the office of professor of divinity. His labors for the college were intense and uninterrupted during the rest of his life. He was widely learned, being particularly versed in the Oriental languages. He published a funeral oration in Latin on Governor Law (1751); a Latin oration on his induction to his office as president (1778); an ‹Account of the Settlement of Bristol› (1785); ‹History of Three of the Judges of Charles I› (1795). His ‹Literary Diary› in 45 volumes, was edited and published by F. B. Denter in 1901. His life has been written by J. L. Kingsley (in Sparks' ‹American Biography,› first series, Vol. VI, 1845), and by Abil Holmes (Boston 1798).

STILETTO, a knife or dagger with a round pointed blade from 6 to 12 inches long, common in the Middle Ages.

STILICHO, stĭl′ĭ-kō, **Flavius,** Roman general: b. of Vandal origin about 359 A.D.; d. Ravenna, 23 Aug. 408. In 384 A.D. he was sent by the Emperor Theodosius on an important mission to Persia where he arranged a peace that was very advantageous to his sovereign and on his return in 384 was made commander-in-chief of the Roman army and given the hand of Serena, the niece of Theodosius, in marriage and with it several high titles and flattering official notice and the following year he was made commander-in-chief of the army in Thrace where he directed the war against the Picts, Scots, Saxons and the barbarians on the Hebrus. In 392 he carried on a very successful campaign against the Bostarnæ, Goths, Alani and Huns. In 394 Theodosius appointed Stilicho guardian of his son Honorius whom he had raised to the dignity of Augustus with sovereignty over Africa, Gaul, Italy and Spain. But as the young man took little interest in affairs of state, this made Stilicho practical ruler of the Western Empire, which he defended against the invasion of the Goths under Rufinus, the guardian of the Empire of the East. He again repulsed the Germanic hordes in 406, and was the loyal servant of the empire in its foreign wars, defeating Alaric at Pollentia. He was accused of aiding Alaric in his encroachments upon the empire previous to its final conquest, and was obliged to flee from Rome. On the charge of high treason he was taken from the church at Ravenna which had given him shelter and executed. He was accused of plotting to put his own son upon the throne; which, it would seem, he came very near accomplishing. His distinguished services in behalf of Rome were commemorated by the poet Claudius. Consult Gibbon, ‹Decline and Fall of Rome›; Hodgkins, T., ‹Italy and her Invaders› (Oxford 1880); Villari, P., ‹The Barbarian Invasions of Italy› (New York 1902).

STILL, Andrew Taylor, discoverer and founder of osteopathy: b. near Jonesboro, Va., 6 Aug. 1828; d. 12 Dec. 1917. With his father, Abram, Methodist minister and doctor, he removed to Tennessee, and at the age of nine to Missouri. At 19 he married Mary M. Vaughn and in 1853 they removed to Kansas, where Mrs. Still died in 1859. He farmed, studied medicine in Kansas City and practised among the pioneers and Indians with his father who had followed him. He fought with John Brown in the border warfare; was elected to the legislature in 1857; was one of the founders of Baker University at Baldwin, Kan. In 1860 he married Mary E. Turner, who lived until 1910. In the Civil War he served in the cavalry and afterward became captain and then major in the 21st Kansas Volunteers which saw considerable service. Ever a student of nature, he decided that the God who made man had placed in the body everything necessary for health, without the use of drugs. He studied the anatomy of the animals he skinned, and dissected many an Indian body in his search for truth. The war interrupted his investigations, but when three of his children died of spinal meningitis in 1864 he attacked the problem anew. In 1874 he announced the science of osteopathy (q.v.). For many years he waged a battle for recognition. For a while he practised as an itinerant doctor in Missouri, at times accompanied by one or more of his sons, and performed wonderful cures with his new science. In 1887 he settled in Kirksville, Mo., which had really been his home since 1875, and developed a large practice.

In November 1892, he opened the American School of Osteopathy, at Kirksville, which now gives a four-year course, and whose clinics and hospital draw patients from all over the United States as well as from Canada. Among his writings are ‹Autobiography› (1897 and 1908); ‹Philosophy and Mechanical Principles of Osteopathy› (1902); ‹Osteopathy, Practise and Research› (1910).

Ray G. Hulburt,
Associate Editor, Journal of Osteopathy.

STILL, John, English ecclesiastic: b. Grantham, Lincolnshire, about 1543; d. Wells, 26 Feb. 1608. He was graduated from Christ's College, Cambridge, of which he was elected a Fellow, and took orders. In 1570 he became Margaret preacher and Margaret professor of divinity in the university. The next year he obtained the rectory of Hadleigh, Suffolk, and in 1572 became, with Dr. Thomas Watts, joint dean of Bocking, at the same time being appointed chaplain to the primate. In 1573 he was made vicar of East Markham and canon of Westminster, whereupon he resigned his Cambridge professorship. He was then promoted to be dean of Norwich and in July 1574 was elected master of Saint John's College, Cambridge. Having acted as vice-chancellor in 1575, he was in May 1577, transferred to the mastership of Trinity. In 1592 he was again elected vice-chancellor and was called upon to provide an English comedy for the queen's amusement. In 1593 he was consecrated bishop of Bath and Wells. The supposition that he was the author of 'Gammer Gurton's Needle' (q.v.) is highly probable. In 1575 the play published under the following title: 'A Ryght Pythy, Pleasant, and Merie Comedie: Intytuld Gammer Gurton's Needle: Played on Stage not long ago in Christes Colledge in Cambridge. Made by Mr. S., Master of Art,' and this Mr. S. can be identified with no one so naturally as with the vice-chancellor, Dr. Still, of the time. (See GAMMER GURTON'S NEEDLE). Consult Dodsley, 'Old Plays' (London 1874–76).

STILL, William, American philanthropist: b. Shamony, N. J., 7 Oct. 1821; d. 1902. He was of African descent; and became chairman and corresponding secretary of the Philadelphia branch of the Underground Railroad, 1851–61. Previous to this he had been a clerk in the Pennsylvania Anti-slavery Society from 1847. During the Civil War he was post-sutler at Camp William Penn for colored troops. He was very active in all movements to help colored people and was member of numerous societies organized to that end. He sheltered the wife, daughter and sons of John Brown while he was awaiting execution in Virginia. He published 'The Underground Railroad'; 'Voting and Laboring'; 'Struggle for the Rights of the Colored People of Philadelphia.

STILL. See DISTILLATION.

STILL-LIFE, a branch of the art of painting which deals with the portrayal of lifeless objects. It is called in Germany, *Still Leben;* in Holland, *stilleven;* in France, *nature morte;* in Italy, *riposo.* The subjects generally chosen are dead animals — deer, birds or fish, kitchen and table utensils, plate, crockery or china, fruit, flowers, curios and jewelry. These objects are arranged so as to make a picturesque combination of color, light and shade. This branch of art flourished from the earliest days of color decoration, and was at its highest perfection during the Alexandrian age; the paintings at Pompeii and the Roman mosaics furnish many fine examples of it. The Renaissance painters did not execute still-life as an independent department of their art, but early in the 17th century it was cultivated most elaborately and with the greatest success by the Dutch school. The taste, beauty, and exquisite virtuosity of their work have never been surpassed, if ever even equaled. There are two main styles of still-life painting. While some artists have endeavored, by a certain breadth and freedom of handling, to obtain a mere decorative effect by the introduction of brilliant metallic surfaces and the juxtaposition of rich color tones, others have aimed at minute and painfully elaborated compositions, fine and delicate as a miniature on parchment or ivory. The chief Dutch painters of still-life are J. Brueghel the elder, Snyders, Leghers, the de Heem family, A. van Beijeren, W. Kalf, Heda, W. van Aelit, Dou and Fyt. In the 19th century a great revival took place in this class of art. In France it was practised successfully by Robie, Vollon, and Ph. Rousseau; in Germany by Preyer of Düsseldorf; Hoquet of Berlin; P. Meyerheim, Hertel, Th. and R. Grönland, and, by the woman painters Begas-Parmentier, H. von Preuschen, Hormuth-Kallmorgan, and Hedinger. The still-life of flowers and fruit is generally most successfully accomplished in water colors. The ancient Greek painter Pausias was especially skilful in the representation of flowers, while of another ancient artist it is said that the birds flew down and picked at his picture of fruit. Among the American painters who have been successful in depicting still-life are W. M. Chase, E. Carlsen and W. Lockwood.

STILLÈ, Alfred, American physician: b. Philadelphia, Pa., 30 Oct. 1813; d. there, 24 Sept. 1900. He studied at Yale University in 1828–30, was graduated at the University of Pennsylvania in 1832 and took his M.D. there in 1836. He studied in Paris and Vienna subsequently at different times after engaging in practice in Philadelphia. He was resident physician at the Pennsylvania Hospital in 1839–41; professor of the theory and practice of medicine at the Pennsylvania Medical College in 1854–59, and at the University of Pennsylvania in 1864–84, afterward being professor emeritus there. He was lecturer on clinical medicine at the Philadelphia Hospital in 1865–71. He was one of the founders of the American Medical Association and became its first secretary, serving as president in 1867. He was one of the first to distinguish typhus from typhoid fever, and attained high rank in his profession both as practitioner and as teacher. Author of 'Medical Instruction in the United States' (1845); 'Therapeutics and Materia Medica' (2 vols., 1860); 'Epidemic Meningitis' (1867), etc. He was joint editor of the *National Dispensatory* (1879).

STILLE, stĭl'ĕ, **Charles Janeway,** American educator and historian: b. Philadelphia, Pa., 23 Sept. 1819; d. 11 Aug. 1899. He was graduated from Yale in 1839 and was admitted to the bar, but abandoned law for literature. In the Civil War he was a member of the United States Sanitary Commission, and in 1866 was made professor of history and English literature in the University of Pennsylvania. He was provost there (1868–80). He published 'Historical Development of American Civilization'; 'History of the United States Sanitary Commission' (1866); Studies in Mediæval History' (1882); 'Beaumarchias and the Lost Milton' (1886).

STILLINGFLEET, Edward, Anglican bishop: b. Cranborne, Dorset, 17 April 1635; d. Westminster, 28 March 1699. He was graduated at Saint John's College, Cambridge, in 1652 and was elected to a fellowship there in 1653. He was appointed chaplain to Charles II in 1668, dean of Saint Paul's in 1678 and became bishop of Worcester in 1689. He was famous for his profound learning, his liberal views and for his untiring efforts to effect a satisfactory compromise between Episcopacy and Presbyterianism. He was brilliant as both a preacher and a writer, and in his lifetime exerted a wide influence. Author of 'Irenicum' (1659); 'Origines Sacræ, or a Rational Account of the Christian Faith as to the Truth and Divine Authority of the Scriptures' (1662); 'Origines Britannicæ, or Antiquities of the British Church' (1685), etc. His collected works were published (6 vols., London 1710).

STILLMAN, Samuel, American Baptist clergyman: b. Philadelphia, Pa., 18 March 1738; d. Boston, Mass., 12 March 1807. He was ordained in the Baptist ministry in 1759, and in 1765 became pastor of the First Baptist Church, Boston, which pulpit he occupied for more than 40 years. He was among the most influential preachers of his day in New England. He was one of the original trustees of Brown University, and was a member of the convention that ratified the United States Constitution in 1788. Author of 'A Sermon on the Repeal of the Stamp Act' (1766); 'Thoughts on the French Revolution' (1794); 'A Sermon Occasioned by the Death of George Washington' (1799), etc.

STILLMAN, stĭl'mạn, **Thomas Bliss,** American chemical engineer: b. Plainfield, N. J., 24 May 1852; d. 1915. He was graduated from Rutgers College in 1873 and went to Germany to study engineering and analytical chemistry. Returning to the United States he was appointed instructor of analytical chemistry at Stevens Institute (1874–76), and was professor there 1881–86. In 1884 he was state oil inspector for New Jersey. He was editor of the 'Stevens Institute Indicator' (1895–98) and has published 'The Rutgers Scarlet Letter' (1873); 'Engineering Chemistry' (1897); 'Examination of Lubricating Oils' (1914).

STILLMAN, William James, American author: b. Schenectady, N. Y., 1 June 1828; d. Surrey, England, 6 July 1901. After graduation from Union College (1848) he studied landscape art with F. E. Church, and in 1849 went to England to continue his art-work. He adopted the views of Rossetti and Millais, whence he was styled "the American Pre-Raphaelite." On return to the United States he began exhibiting at the Academy of Design, of which in 1854 he was made an associate. In 1852 he went for Louis Kossuth to Hungary to secure the crown-jewels which had been secreted by Kossuth at some point on the Danube. After some further study with Yvon at Paris, he came back to found with John Durand, the *Crayon*, a magazine of art criticism, which continued two years (1855–57). In 1859 he was again in England and in 1861–65 was United States consul at Rome, and in 1865–69 he held a similar post in Crete. Having abandoned art, owing to failing eyesight, he was a special correspondent for the *Times* of London from 1878 to 1898, traveling widely about the continent, and being from 1886 correspondent for Italy and Greece. In 1883–85 he contributed critical papers on art subjects to the New York *Evening Post*. An expert photographer, he was at one time associate editor of the *Photographic Times*. He made for the Hellenic Society of London a valuable series of photographs of the Acropolis at Athens, and published (1872–73) two manuals of photography. As a journalist he wrote much on many subjects, chiefly art, history and politics, and gained a considerable reputation. His best picture is 'The Procession of the Pines' (1858). Among his published volumes are: 'History of the Cretan Insurrection' (1874); 'Herzegovina and the Late Uprising' (1877); 'On the Track of Ulysses' (1887); 'The Union of Italy' (1898); 'The Old Rome and the New' (1898); 'Francesco Crispi' (1899); and an interesting 'Autobiography' (Boston 1901, first printed in the 'Atlantic' 1900).

STILLWATER, stĭl'wâ"tẽr, **Minn.,** city, county-seat of Washington County, on Saint Croix River, 30 miles from its junction with the Mississippi River, and on the Chicago, Milwaukee and Saint Paul, the Northern Pacific and the Chicago, Saint Paul, Minnesota and Ohio railroads, about 18 miles northeast of Saint Paul. It has steamer connections with the river ports and regular connection with Dubuque and Saint Louis. It was settled in 1840, and incorporated as a city in 1854. The Saint Croix River boom, through which pass each year about 300,000,000 feet of pine logs, is north of and near the city. Stillwater is in an agricultural region, and is extensively engaged in manufacturing. The chief industrial establishments are flour and feed mills, grain elevators, lumber mills, foundries, machine shops, carriage and wagon works, and furniture factories. The city has a large trade in logs, lumber and lumber products, wheat, flour and livestock. It is the commercial and industrial centre of the Saint Croix lumber region in Minnesota and Wisconsin and has grain elevators, machine shops, foundries, breweries, brickyards, boat and wagon factories. The educational institutions are a high school, public and parish elementary schools, private business schools, two convents, the Minnesota State prison, and the Carnegie library. The government is vested in a mayor and council of nine members, three of whom are elected each year. Stillwater was first located on the plain bordering on Lake Saint Croix, with bluffs outside the settled portion. Now the old part of the city is given up to trade and manufacturing houses and the residential portion is on the bluffs. Pop. about 11,000.

STILLWATER, Battles of. See SARATOGA, BATTLES OF.

STILLWELL, Lewis Buckley, American electrical engineer: b. Scranton, Pa., 12 March 1863. He was educated at the Wesleyan and Lehigh universities, and in 1886 established himself in New York as a consulting electrical engineer. He was chief engineer of the Westinghouse Electrical Company in 1891–97; electrical director of the Niagara Falls Power Company in 1891–1900; of the Rapid Transit Subway Construction Company in 1900–08, and consulting electrical engineer to the Manhattan Railroad Company in 1900–04, and to the Hudson Company from 1904. He was president of the American Institute of Electrical Engineers in 1909–10.

STILT, or FROST-BIRD. See SANDPIPER.

STILTED ARCH, *in architecture,* an arch which does not spring immediately from the imposts, but from a vertical piece of masonry resting on them, so as to give the arch an appearance of being on stilts. Arches of this kind occur frequently in all the mediæval styles.

STILTS, wooden poles with steps or foot supports at a sufficient distance from the ground to allow a person standing on the steps to walk with long strides. Stilts are very useful in marsh lands and were formerly very popular in the French Landes. In various European countries stilts are used by the peasants for crossing streams.

STIMSON, Frederic Jesup, American lawyer and author, known also by the pen-name «J. S. of Dale»: b. Dedham, Mass., 20 July 1855. Graduated from Harvard in 1876 and from the law school of the institution in 1878, he entered practice in Massachusetts and was assistant attorney-general of that State in 1884–85. He was secretary to the National Conference on the uniformity of law in 1892; was made counsel to the United States Industrial Commission, and lectured at Harvard on legislation. He published ‘Stimson's Law Glossary’; ‘American Statute Law’; ‘Handbook to the Labor Law of the United States’ (1896); ‘Labor in its Relation to Law’ (1896); and in fiction, among several other works, ‘Guerndale’ (1882); ‘The Crime of Henry Vane’ (1883); ‘The Residuary Legatee’ (1887); ‘First Harvest’ (1889); ‘King Noanett’ (1896); ‘Jethro Bacon of Sandwich’ (1901); ‘In Cure of her Soul’ (1906); ‘The American Constitution’ (Lowell Institute Lecture, 1906); ‘The Law of the Constitutions, State and Federal’ (1907); ‘Popular Law-making’ (1910); ‘The Light of Provence’ (poem-play); ‘My Story: An Imagined autobiography of Benedict Arnold’ (1917).

STIMSON, Henry Albert, American Congregational clergyman: b. New York, 28 Sept. 1842. He was graduated from Yale in 1865, and studied in the Union and the Andover Theological seminaries. He has held pastorates in several American cities including New York; is a lecturer at the Chicago Theological Seminary; and has published ‘Religion and Business’ (1894); ‘Questions of Modern Inquiry’ (1894); ‘The Apostles' Creed’ (1899); ‘The Right Life’ (1905); ‘The New Things of God’ (1908); ‘Behind the World and Beyond’ (1910); ‘While the War Raged’ (1914); and many articles in magazines and newspapers. Was recording secretary of the American Board of Commissioners for Foreign Missions (1881–1915); vice-president, American Missionary Association and American Tract Society; director of Seaman's Friend Society and American Bible Society; president of Board of Visitors, Andover Theological Seminary; trustee of Carleton College, Drury College and Mount Holyoke College; director, Chicago Theological Seminary and Hartford Theological Seminary; president, Congregational Board of Ministerial Relief; president of Congregational Annuity Fund for Ministers; vice-president, Congregational Church Extension Society; and president of Congregational Church Building Society. Has degrees of M.A., and S.T.D., from Yale and D.D., from Ripon.

STIMSON, Henry Lewis, American lawyer and cabinet officer: b. New York, 21 Sept. 1867. He was graduated at Yale University in 1888, at Harvard in 1889 and at the Harvard Law School in 1890. He was admitted to the bar in 1891 and engaged in practice in New York. He became a member of the law firm of Root and Clarke in 1893, of Root, Howard, Winthrop and Stimson in 1897 and of Winthrop and Stimson in 1901. He was United States district attorney for the southern district of New York in 1906–09; unsuccessful candidate for governor of New York in 1910, and in 1911–13 he was Secretary of War under President Taft. He was a delegate to the New York State Constitutional Convention in 1915.

STIMSON, John Ward, American artist: b. Paterson, N. J., 16 Dec. 1850. He was graduated from Yale in 1872, and from École des Beaux Arts, Paris. He became lecturer and art teacher at Princeton University, and was for four years director of the art schools of the Metropolitan Museum of Art, New York. He founded the Artist-Artisan Institute, New York, 1888, and later became director of the Art and Science Institution, Trenton, N. J. He is a brother of Henry Albert and Lewis Atterbury Stimson. He is a popular lecturer on art, and has published ‘The Law of Three Primaries’; ‘Principles of Vital Art Education’; ‘The Gate Beautiful’; and ‘Wandering Chords.’

STIMSON, Lewis Atterbury, American surgeon: b. Paterson, N. J., 1844. He was graduated from Yale University in 1863 and received the degree of M.D., from the same institution in 1874. He served as captain in the Union army during the Civil War. In 1893 he was a Regent of the University of the State of New York, and is professor of surgery in Cornell University (1904). He has published: ‘Operative Surgery’ (1900); ‘Fractures and Dislocations’ (1900).

STIMULANTS, agents which temporarily increase the vital activities, either in particular organs and functions or in the whole physical organism. They are among the most valuable and important of medicines, and perhaps are more often the direct means of saving life than any others. But as they are powerful, their injurious effects, when misapplied, have been even more prejudicial to mankind than their best use has been beneficial. In fact it may be said that the abuse of this class of medicines, under the names of cardiacs, cordials, alexipharmics, etc., caused more deaths during the dark ages of medicine than did sword and pestilence united. The dreadful mortality of smallpox and fevers during the Middle Ages, and even as far down as the earlier parts of the 19th century, was mainly owing to the administration of heating stimulants, the tendency of which was to increase the violence of the disease, although they were intended merely to expel noxious and poisonous humors. But by a more cautious use of these articles they are the means of preserving life. Stimulants are either simple and direct in their operation, as the external application of heat in all forms, dry and moist, by friction, etc.; the application to the stomach of hot liquors, spices, camphor, hartshorn, warm and aromatic gums and oils, as mint, cardamon, cajeput, ginger, asafœtida, red pepper, spirits of turpentine, etc.; or they act first as stimulants, but produce afterward effects of a different character, as is the case with wine, brandy and spirits of all sorts; opium, ammonia, ethers, etc., all of which are highly stimulant at first, and in small quantity, but afterward, and when taken in larger doses, produce exhaustion, debility, sleep and death. The first class are upon the whole the safer, and should always be used in preference to the last when they can be had, in cases of suspended animation from cold, drowning, suffocation, etc.; while the others are more valuable for their secondary and remote effects, by means of which they ease pain, and relieve spasm and other affections; and for these purposes they should be used freely, as they can do no hurt while the violence of the disease persists. But they should never be resorted to unless pain is urgent, or debility become so great as to endanger life.

STINDE, stĭn'dĕ, **Julius,** German humorist: b. Kirch-Nüchel, in the eastern part of the province of Holstein, 28 Aug. 1841; d. Olsberg (bei Kassel), Westphalia, 7 Aug. 1905. He attended the gymnasium at Eutin, near his native village, became an apothecary in 1858, and then attended the universities of Kiel, Giessen and Jena to study chemistry. For several years he served (1863–66) as a chemist attached to factories, but made simultaneous attempts to enter journalism. From 1864 to 1868 he was editor of the *Hamburger Gewerbeblatt,* from 1865 to 1875 of the *Reform.* He resided in Berlin after 1876. His stories of Berlin life depict the commercial lower middle class of the large cities, especially in communities that are expanding successfully. His most successful types are the members of the Buchholz family, who, in their life at home, and in their travels in Italy and elsewhere, retain constantly the coarse but healthy humor that is characteristic of their class, with that certain Berlin or metropolitan superciliousness which is as unmistakable as it is unpleasant. So successful was Stinde's exploitation of their foibles, that he settled down to a sort of factory production, turning out nothing but repetitions of the same types, which never failed to yield the expected financial return. Among his best known stories are ‹Buchholzens in Italien› (1883; 54th ed., 1905); ‹Die Familie Buchholz› (3 vols. 1886; 87th ed. 1905); ‹Frau Buchholz im Orient› (1889); ‹Frau Wilhelm Buchholz' Memoiren› (1895); ‹Hotel Buchholz› (1897). His comedy on the same subject, ‹Bei Buchholzens› (1900), was not a success. Consult Cherbuliez, ‹Profils étrangers› (Paris 1889); Meyer, R. M., ‹Die Ahnen der Familie Buchholz› (Berlin 1905).

JACOB WITTMER HARTMANN.

STINESS, John Henry, American jurist: b. Providence, R. I., 9 Aug. 1840; d. 3 Sept. 1913. He graduated at Brown University in 1876; studied law, admitted to the Providence bar (1868) and practised law there until he was appointed judge of the Supreme Court of Rhode Island, 1893. He was a member of the Rhode Island House of Representatives (1874–75), and Associate Justice (1875–1900); and Chief Justice of the Supreme Court of Rhode Island (1900–04); has written ‹History of Lotteries in Rhode Island› and ‹Liquor Legislation in Rhode Island›; ‹Civil Changes in the Senate.›

STING, a weapon possessed by many plants and small animals, in various forms, employed to pierce and in most cases also to poison, the flesh of animals to be killed for food, or from which injury is received or expected. In plants this office is performed by stiff, sharp, hollow hairs emitting an acrid juice. (See NETTLE.) Such stinging-hairs sometimes cause extreme irritation in the skin and mucous membranes of even the largest animals, and hence cause the plants to be avoided, thus protecting the species against harm. The simpler marine animals (*Cœlenterates*) are widely defended by stinging instruments, consisting of coiled poison-carrying threads which dart from microscopic capsules in the surfaces of the integument. (See NEMATOCYSTS; JELLY-FISH). Insects are plentifully provided with piercing weapons. These in some cases are mouth-parts and in others are modified ovipositors. To the first class belong the sharp prolonged jaws, many plant-sucking bugs, or blood-sucking ones, such as the bed-bug, cone-nose (qq.v.) and others. In another group are found the gnats and mosquitoes, which inflict pain upon large creatures and death upon minute ones by stabbing with their complicated beaks, which consist of a bundle of lancets and saws. (See MOSQUITO). Many caterpillars are defended by nettle-like hairs, each of which is a specially modified spine and able to inflict so great annoyance that hairy caterpillars generally are studiously avoided by most animals. The «sting,» properly speaking, however, is found among insects only in the hymenoptera, as bees and wasps, where it is a modified ovipositor (q.v.). In wasps (q.v.) it serves a special purpose in paralyzing the insects stowed away alive with the eggs in the nest cells. Spiders are said to «sting,» but in reality they bite, in some cases, poison. Scorpions, however, possess what is properly enough termed a sting in the pointed telson or tail-piece appended to the extremity of the abdomen, with which a poison-infected puncture is inflicted (see SCORPION). Some fishes, as the sticklebacks, surgeon-fish, and notably the sting-rays (q.v.), has certain defensive spines, by which highly irritating wounds may be inflicted. The use of the fangs by poisonous snakes, also is often spoken of as stinging.

STING-RAY, or **STINGAREE, STINGOREE,** a fish-ray of the family *dasyatidæ* remarkable for the long, flexible, whip-like tail, which is armed near its root with an erectile spine or spines, very sharp at the point, and furnished along both edges with sharp cutting teeth. It inflicts a painful, poisonous wound. In some of the numerous members of this family, two or even three spines are bundled together. In Great Britain the sting-ray is called the fire-flare, or sometimes fiery-flare. In the United States it is often called the clam-cracker. See RAY.

STINK-BUG, any of several small heteropterous plant-feeding bugs, allied to the squash-bugs, which emit a vile odor. The name is generally applied to the common squash-bug.

STINK-HORN FUNGUS. See FUNGI.

STINK-POT, a malodorous kind of box-turtle (q.v.).

STINKING MAY-WEED. See FENNEL.

STINKWOOD, a tree (*Oreodaphne fœtida*) of the family *Lauraceæ*, a native of the Cape of Good Hope, remarkable for the strong disagreeable smell of its wood, which, however, is hard, very durable, takes an excellent polish and resembles walnut. It has been used in shipbuilding.

STINT. See SANDPIPER.

STIPA, feather-grass; an important genus of grasses (q.v.).

STIPEND, a payment at stated periods for services rendered, and generally used in connection with official or ecclesiastical salaries. It is not officially used, however, except in Scotland, where the provisions for the support of the parochial minister of the established church is designated as a stipend.

STIPENDIARIES. See MERCENARIES.

STIPPLE ENGRAVING. See ENGRAVINGS.

STIPULES, *in botany*, are organs connected with the leaves, existing only in the dicotyledonous plants. They are small scale-like or leafy appendages at the point where the leaves come off from the stem, and are commonly in pairs. there being one on each side of the petiole, as in the hornbeam and lime. They are more frequently free, not being attached to the petiole; but sometimes they are united to the base of that organ, as in the genus *Rosa*. The stipules afford excellent characters for the arrangement of plants. When a vegetable of a natural order has these organs, it is very seldom the case that all the others are not equally provided with them. Thus they exist in all plants of the natural orders *Leguminosæ*, *Rosaceæ* and *Tiliaceæ*. As they fall off very easily when they are free, their absence might sometimes induce one to suppose a plant destitute of them, but this error may be avoided by observing that they always leave on the stem, at the place where attached, a small cicatrix, which attests the fact of their having existed. They vary greatly in their nature and consistence. They may be foliaceous or leaf-like, as in the common agrimony; membranous, as in the fig and magnolia; spinescent or thorny, as in the jujube and gooseberry. Some fall off before the leaves, as in the common fig and the lime; others are merely deciduous, or fall at the same time as the leaves; and there are others which continue for a longer or shorter time after the leaves have fallen, as in the jujube and gooseberry. The use of the stipules appears to be to protect the leaves before their expansion, as is evidently shown by their relative disposition in the buds of some orders of plants. See LEAVES.

STIRLING, Edward Charles, Australian anthropologist: b. Strathalbyn, South Australia, 8 Sept. 1848. He was educated at Cambridge University and London where he graduated in medicine. He became lecturer in London; but returned to South Australia in 1881 as professor of physiology in the University of Adelaide, consulting physician at the city hospital and director of the South Australian Museum. He was a member of the House of Assembly, 1883–86. His published works include 'Anthropology of Central Australia'; 'The Horn Scientific Expedition'; and a vast amount of scientific work contributed to journals and magazines.

STIRLING, James Hutchinson, Scottish philosopher: b. Glasgow, 22 June 1820; d. 1909. He was educated in arts and medicine in Glasgow University, France and Germany; and practised as a surgeon in Wales for some years, but ultimately devoted himself to travel, study and literary and philosophical pursuits. He is the author of 'The Secret of Hegel' (1865); 'Sir Wm. Hamilton, being the Philosophy of Perception' (1865); 'Jerrold, Tennyson, Macaulay and other Essays' (1868); 'As Regards Protoplasm' (1869); 'The Philosophy of Law' (1873); 'Burns in Drama, together with Saved Leaves' (1878); 'Text-book to Kant' (1881); 'The Community of Property' (1885); 'Philosophy and Theology' (the Gifford Lectures, 1890); 'Darwinianism, Workmen and Work' (1894); 'What is Thought?' (1900); 'The Categories' (1903); and translator of Schwegler's 'History of Philosophy,' and Kant's 'Critique of Pure Reason in his Text-book to Kant.' Consult Stirling, A. H., 'James Hutchinson Stirling' (London 1912).

STIRLING, John William, Canadian oculist, aurist and surgeon: b. Halifax, Nova Scotia, 2 July 1859. He was graduated in medicine at the University of Edinburgh in 1884 and later studied at the universities of Berlin and Vienna. He engaged in practice in Montreal in 1887 as an ophthalmological and aural surgeon. Since 1906 he has been professor of ophthalmology at McGill University. He is also oculist and aurist to the Montreal General Hospital and surgeon oculist to the Royal Victoria Hospital. Author of numerous papers on ocular diseases.

STIRLING, William Alexander, EARL OF, Scottish poet and colonial proprietor: b. about 1567; d. London, 12 Sept. 1640. He was educated at Glasgow and in Germany. His tragedy 'Darius' was published in 1603, and was followed by three others, 'Crœsus'; 'The Alexandrian Tragedy,' and 'Julius Cæsar,' which were collected under the title, the 'Monarchicke Tragedies,' in 1607. He also wrote a number of sonnets, but is best known as a recipient from James I of a grant bestowing upon him, under the name of Nova Scotia, the whole of the eastern portion of Canada, and the patent of sole printer for 31 years of King James' version of the Psalms. The conquests of France in Canada, however, deprived him of practically all of his grant. Consult Charles Rogers, 'Memorials of the Earl of Stirling and the House of Alexander' (1877).

STIRLING, Yates, American rear admiral: b. Baltimore, Md., 6 May 1843. He was graduated at the United States Naval Academy in 1863, and in 1863–65 served on the *Shenandoah* in the North Atlantic blockading squadron, participating in both actions at Fort Fisher.

He was promoted commander in 1880, captain in 1894 and rear-admiral in 1902. He was commandant of the naval station at San Juan, Porto Rico, in 1900–02; of the navy yard in Puget Sound in 1902–03; commander of the Philippine squadron of the Asiatic fleet in 1903–04, and of the cruiser squadron of that fleet in 1904, while in 1904–05 he was commander-in-chief of the Asiatic fleet. He was retired upon reaching the age limit in 1905.

STIRLING (formerly **STRYVELYNE** or **ESTRIVELIN**), a river-port, city and county in Scotland: (1) county-seat of Stirlingshire, on the south side of the Forth, 29 miles northeast of Glasgow. It occupies a commanding site, Castle Hill, resembling its namesake at Edinburgh. The castle is of great historical interest. It contains the rooms where Douglas received a mortal stab from James II, who, as well as James V was born in this castle; and the Parliament-house, chapel-royal. The view from the battlements comprehends many of the lochs and fertile vales of Scotland, the winding river and the Grampian and Ochil hills, together with the ruins of Cambus-Kenneth Abbey and the Bridge of Allan. Within the town, Greyfriars Church, begun by James IV, museum, library, picture-gallery, several ancient mansions and monuments deserve notice. The manufactures of the town include: woolen, cotton and linen goods, carpets, leather, malt, soap, mineral oils, ropes and carriages. The salmon-fisheries are profitable. There is little trade. Pop. about 22,000. (2) Stirlingshire is a county of South Scotland with an area of about 466 square miles. About one-third of the county is hilly, and rises in Ben Lomond to a height of about 3,000 feet. Here the Forth flows into the Firth of Forth, coming from Ben Lomond. The southeastern portion is traversed by the Forth-Clyde canal. The famous Loch Katrine forms one of the numerous lochs or lakes. The valleys and plains are exceedingly fertile and highly cultivated. There are a few marshy lands. The country is rich in minerals, especially iron and coal. The chief industries in addition to those mentioned in connection with the city of Stirling are the working of the mines. The chief towns besides the capital are Falkirk, Grangemouth and Kilsith. Consult ‘History of the Chapel Royal of Stirling’ (published by the Grampian Club); and ‘The Charters of Stirlin’ (by same as above).

STIRLING'S PLANTATION ON BAYOU FORDOCHE, Engagement at. On 5 Sept. 1863, General Herron's division of the Thirteenth corps, General Banks' army, embarked on transports at Carrollton, La., and sailed up the Mississippi to disperse a Confederate force under Gen. R. Taylor, which was then on the west side, below the mouth of Red River, seriously threatening the navigation of the river. Morgan's Bend was reached on the 7th, from which point, on the morning of the 8th, about 200 cavalry and a brigade of infantry, under Col. H. M. Day, moved out on a reconnoissance toward the Atchafalaya River, and encountering the Confederate pickets, drove them across the Atchafalaya and then fell back three miles. On the 9th Day was joined by General Herron, with another brigade, and a second reconnaissance was made to the Atchafalaya, where there was a smart skirmish, and Herron fell back to the river, with a loss of a few men killed and wounded. On the 12th the cavalry was again sent to the front to feel the enemy, and the 19th Iowa, 26th Indiana and two guns were sent out seven miles to the vicinity of Atchafalaya Bayou to picket the country and support the cavalry. All were under command of Lieut.-Col. J. B. Leake, of the 20th Iowa. Leake had a skirmish with the enemy and fell back to Stirling's Plantation, on Bayou Fordoche, about six miles from Morganza, from which point he sent out parties daily, which skirmished with the Confederates. On the night of the 28th Gen. Thomas Green, with two brigades of Confederate infantry, one of cavalry and mounted infantry, and a battery, crossed the Atchafalaya, and by different routes reached the rear and flanks of Leake's command, by marching through swamps and canebrakes, and about noon of the 19th fell upon his unsuspecting camp. The cavalry was soon driven from the field, and managed to escape with small loss; the infantry made a gallant stand and fought desperately, but attacked on all sides, were soon overpowered and captured, with the two guns. Leake was severely wounded. The Union loss was 16 killed, 45 wounded and 454 missing or captured; the Confederate loss, 26 killed, and 85 wounded. Consult ‘Official Records’ (Vol. XXVI).

STIRNER, stĕr'nĕr, **Max,** German philosopher, a pseudonym for JOHANN KASPAR SCHMIDT, b. Bayreuth, 25 Oct. 1806; d. Berlin, 26 June 1856. His reputation is based upon a single book, ‘Der Einzige und sein Eigentum’ (1845, English tr. ‘The Ego and his Own,’ by S. T. Byington, London 1913). After completing his gymnasium course in his native town (1819–26), he attended the University of Berlin (1826–28), where he heard lectures chiefly on philosophy and theology under Hegel, Schleiermacher, Neander, Marheineke and others. His next university was that of Erlangen (1828–29), which he left for that of Königsberg, not attending any lectures at the latter institution, however, for «family reasons,» the nature of which is not known, any more than the manner in which he distributed his time between Königsberg and Kulm in East Prussia (the new home of his parents) in 1830–32. The year 1832–33 was again spent at the University of Berlin, after the completion of which he applied for a certificate as a teacher in Prussian gymnasiums. He wrote two papers as part of the requirement for this position, one on Thucydides, the other on the School Laws, the latter showing considerable revolutionary spirit. He served as teacher in training (*Probekandidat*) without pay at the Berlin Königliche Realschule for a year and a half, and married Agnes Burtz (1815–38), who (with her child) died in childbirth after a very short marriage. Stirner seems to have kept away from government institutions after his first experience in teaching, and obtained a position in the Girls' School of Madame Gropius (later the Misses Zepp), in Berlin, which he held from 1839 to 1844. Little is known of his life, beyond the data given above. For several years after 1841 he was the most regular attendant at the meetings of an irregular organization known as «Die Freien» (The Free), which met in Hippel's Weinstube on Friedrichsstrasse and elsewhere, none of the other members of which attained much fame. A few occasional visitors to the place expressed themselves unfavorably as to its rather loose tone. Karl Marx, who was present once, never met Stirner, as the latter joined after Marx's departure. Stirner married, as his second wife (21 Oct. 1843), Marie Dähnhardt (1818–1898?), who after his death asserted that he had deceived and neglected her, and who probably had little understanding for his philosophical work. They separated in 1846, after which time Stirner led an irregular life in furnished rooms. The house in which he died (Berlin NW, Philippstrasse 19) has been marked with a tablet since 1898.

Stirner's great work, ‘The Ego and His Own,’ met with sensational success on its first publication (1845), but passed into a relative oblivion, and did not again attract attention until the superficially similar philosophy of Nietzsche began to be widely read (about 1895). It is a work in excellent aphoristic style, apparently an anarchistic attack on all human society, on co-operation and institutions of every kind, on the human race itself. Obedience to any form of authority is derided, respect for the traditions of the past scorned. The Ego is the supreme law, external obligations and submissions to them are concessions to the “spooks” with which the world is infested. Laugh at them, and they melt away. A careful reading will convince the reader, however, that Stirner was not an anarchist, and that his propaganda was an attack on those ideological compulsions (church, state, monarchy, etc.) that are not based on the real needs of humanity, and displays a considerable analogy with the destructive portions of the social criticism of Karl Marx (whose ‘Deutsch-französische Jahrbücher’ the book quotes unfavorably), without any of the latter's constructive method. All of Stirner's other writings seem to have been chiefly general literary work: a translation of Adam Smith's ‘Wealth of Nations’ (4 vols.), of the French economist Jean Baptiste Say's ‘Handbuch der praktischen politischen Ökonomie’ (4 vols.), and an original work: ‘Geschichte der Reaktion’ (2 vols. 1852), which sketches the practices of the reactionary classes following the French Revolution as well as of the same classes in the German Revolution of 1848. Robert Giseke (1827–1890) published a novel, ‘Moderne Titanen’ (Leipzig 1850), of which Stirner is the hero (under the name Horn). Consult Adler, M., ‘Wegweiser: Studien zur Geistesgeschichte’ (Stuttgart 1914); Carus, P., ‘The Predecessor of Nietzsche’ (Chicago 1911); Mackay, J. H., ‘Max Stirner’ (Berlin 1910); Messer, M., ‘Max Stirner’ (Berlin 1907); Ruest, A., ‘Max Stirner’ (Berlin 1906); Zoccoli, E., ‘I gruppi anarchici degli Stati Uniti e l'opera di Max Stirner’ (Modena 1901); Stirner, M., ‘Kleinere Schriften,’ ed. by J. H. Mackay (Berlin 1907).

JACOB WITTMER HARTMANN,
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STIRRUP, an article of equestrian equipment with which the ancients were not acquainted. The Roman youth were accustomed to leap upon their horses sword or lance in hand. Distinguished persons and old men had servants to place them on their horses, and conquered sovereigns were often compelled to perform this office for their vanquishers.

STITCHWORT, plants of the genus *Alsine*, belonging to the pink family, *A.* (*Stellaria*) *holostea*, most properly bears the name. It is an Old World species, an erect, but low, hardy perennial, with slender stems and opposite grass-like leaves, which are sessile and usually glabrous. The flowers are five-merous, the petals deeply cleft, and are showy, being three-fourths of an inch wide and very numerous. They are gathered in leafy panicles and fairly cover the plants with bloom. For this reason stitchwort is cultivated as a border plant. It was reputed to be a cure for a “stitch in the side” and even for snake-bites. It has many other names, as shirt-buttons, all-bone and snap-jack, the latter referring to its brittle nodes.

STITH, William, American colonial historian: b. Virginia, 1689; d. Williamsburg, Va., 27 Sept. 1755. He studied theology, was ordained in England to the ministry of the Established Church, was chaplain of the Virginia house of burgesses, and in 1752–55 rector of Henrico parish and president of William and Mary College. He published a ‘History of the First Discovery and Settlement of Virginia’ (1747), which De Tocqueville criticised as “long and diffuse,” but it is nevertheless a standard work on early Virginian history, and written with excellent scholarship. It was the only published instalment of an extended work planned by the author, and reaches as far as the dissolution of the London Company. It is prepared from the colonial archives, Sir John Randolph's papers, the ‘Records’ of the London Company, and the Byrd library. It was re-edited and published with a biography in 1866.

STIVER, a former Dutch coin and money of account worth about two cents.

STOAT, “The British name of the common European weasel.”

STOBÆUS, Johannes, Greek grammarian and critic: b. Stobi, Macedonia, of the latter half of the 5th century. For the education and improvement of his son Septimius, he compiled a florilegium of Greek literature, for which he drew upon about 500 Greek poets, historians and philosophers. This has formed one of the most precious legacies which ancient scholarship has bequeathed to posterity. His works contain citations and quotations from many lost works and have been of immense assistance to modern Greek criticism. The original work was composed under the single title ‘Anthologion,’ but the scholars of the Middle Ages divided it into two parts ‘Eclogæ Physicæ et Ethicæ’ and ‘Florilegium,’ which were edited by Gaisford and published at Oxford, the former in 1825; the latter in 1850. There is a good edition of his works published by Wachsmuth and Hense (Berlin 1884–1909). Consult Christ-Schmid, ‘Geschichte der Grieschen Literatur’ (Munich 1913).

STOCK. See BATHOLITH.

STOCK, a popular name for several species of cruciferous flowering plants long favorites in gardens. The Virginian stock (*Malcomia maritima*) is a hardy annual herb which grows wild in the Mediterranean region. It is of simplest culture and will thrive well in cities without apparently impairing its beauty or fragrance. The common autumnal queen, or Brompton stock (*Matthiola incana*) is a biennial or perennial semi-woody herb or sub-shrub, a native of the Mediterranean region and the Isle of Wight. The intermediate or ten-weeks stock (*M. incana*, var. *annua*) is considered by some botanists to be a distinct species, but except for its annual habit it differs little from the preceding and is, therefore, ranked as a variety. Both are known as gilliflower or gellyflower and are widely cultivated for their variously colored, deliciously fragrant flowers which in many varieties are double. The latter usually are sown very early and successionally so as to bloom during the early summer months; the former are planted somewhat later so as to continue the blossoming into the autumn. They are about as easy to grow as geraniums and require fairly rich friable garden soil, good drainage, but plenty of moisture, and clean cultivation. There are about 30 other species, some of which are cultivated and several of which are fragrant only at night.

STOCK (Anglo-Saxon, *stoce*, post, trunk, stick) *in law*, represents the capital of corporations and is usually divided into shares of a definite value denoting the rights in the assets, profits and management of the company possessed by the members of the corporation or the persons contributing the capital. A certificate of stock is a mere evidence that the person therein designated is entitled to an interest in the company, which is stated. Shares of stock may be of any value the company sees fit to set, and the par value may not, and in fact, generally is not the selling price of the stock. In the United States some States have a law requiring stock to be issued at its par value. Stock may be divided into several classes, for example, as common and preferred; holders of the common stock have an equal right in the company and its profits; holders of the preferred stock are entitled to a preference over other shareholders but they are not creditors of the corporation. Dividends on stock represent a division of the surplus or net profits arising from the business of the company. Stock is considered as personal property and may be transferred at the will of the owner by proper assignment of the certificate. This is generally done by having the name of the purchaser of the stock placed legally upon the books of the company in the place of that of the seller. The purchaser of stock from a stock-owner should have his name entered at once on the books of the company to prevent fraud on the part of the seller who might have the name of some one else entered. This would stand good, in so far as the company was concerned. (See STOCKHOLDER; STOCK EXCHANGE; CORPORATIONS). Consult Cook, 'Treatise on the Law of Corporations' (Chicago 1903); Dos Passos, 'The Law of Stock Brokers and Stock Exchanges' (New York 1905). The capital stock of a company is the amount fixed by the charter of a corporation as the sum already paid or to be paid into its treasury for use in the carrying on of its business operations. This does not include the actual property owned by the corporation or company.

STOCK BREEDING, the art of producing and rearing domestic animals, particularly those of greater agricultural value known as farm live stock, including cattle, horses, pigs, sheep and fowls. The successful practise of this art depends upon an intimate knowledge of the particular kind of stock to be bred and a familiarity with certain general principles applicable to the breeding of stock of various kinds. The special knowledge of each kind of live stock can best be obtained by actual farm experience under skilled supervision but much useful information can be obtained from live stock manuals, which describe the breeds of farm animals and their management. To impart such information is also the aim of courses of instruction in animal husbandry and poultry management given in agricultural colleges.

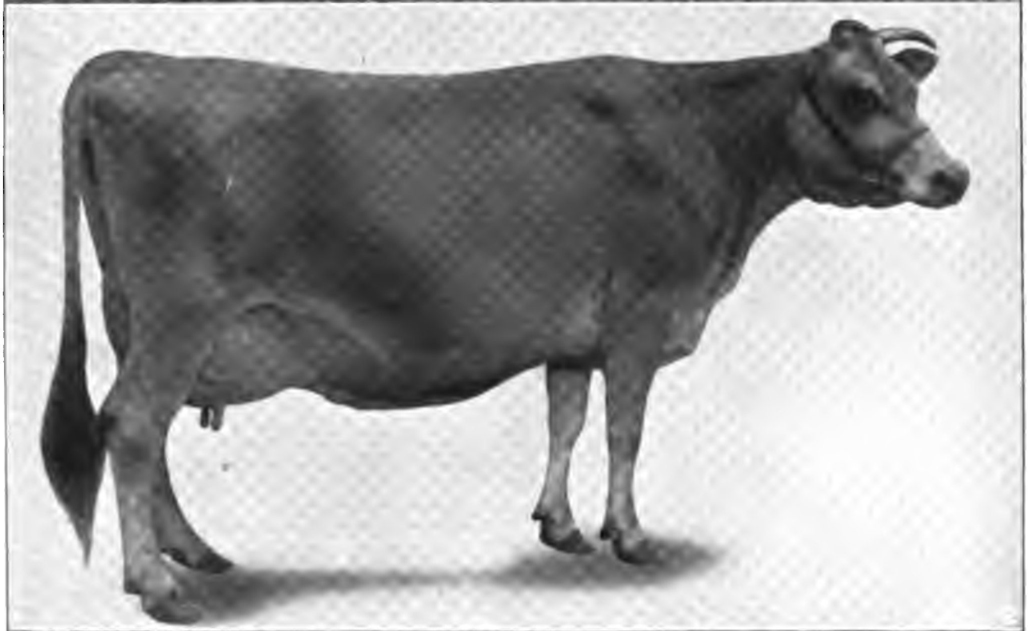
General Principles.— The discovery of general principles applicable in stock breeding is a work to which agricultural experiment stations are appropriately giving much attention. Investigators in universities and research institutions have made important contributions in this field through their studies of variation and heredity. See article GENETICS.

To propagate any kind of animal successfully the breeder should know its life history thoroughly, under what climatic conditions it attains sexual maturity or becomes sexually active, what is its period of gestation or incubation, at what age full size and productiveness are attained, when senility begins, what are the best feeds and how to prepare them, and other similar facts.

The successful breeder will employ all knowledge of this sort which he possesses in controlling and utilizing the activities of his animals to serve the purpose which he has in mind. What that purpose is will determine both the choice of foundation stock and his management of it. For example, breeding cattle for milk production, for butter making, for cheese making or for beef require in each case a different choice of foundation stock and different management of it.

The question of when and how man acquired domestic animals, while of little present practical concern, has much scientific interest. A complete answer to it might show whether domestication of other animals is likely to occur in the future and if so under what conditions. Its solution would also throw much light on the early history of man and the rise of civilization. Present knowledge indicates that man as distinct from other primates originated in Central Asia and at first utilized for food and clothing wild plants and wild animals, as the most primitive races of mankind still do. Later, plants began to be cultivated and animals kept and reared in captivity to insure more dependable supplies of food and clothing. In Asia man domesticated the dog, sheep, goats, the ass, cattle, horses and pigs. All of our more important farm animals originated with man in his old home, Central Asia, in a remote, prehistoric period. With man they were taken in migrations into Europe and Africa. The migration of man into America from Asia occurred undoubtedly at a very early period. The dog was the only domesticated animal that came with the emigrants from Asia to America. Pos-

STOCK BREEDING



1 Raleigh's Oxford Prince, A. J. C. C. 123167. Grand Champion Jersey Bull at the National Dairy Show, Columbus, Ohio, 1918. Bred, raised and exhibited by Edward C. Lasater, Falfurrias, Texas. 2 Great Scot's Champion, A. J. C. C. 208703. Grand Champion Cow at National Dairy Show, Chicago, 1911. Register of Merit, record 11,138.6 lbs. milk and 774 lbs. 4 ozs. of butter, in her 13th year. Owned by Edward C. Lasater, Falfurrias, Texas. 3 First Prize Breeders' Young Herd, at National Dairy Show, Columbus, Ohio, 1917, bred and exhibited by Edward C. Lasater, Falfurrias, Texas. This is the most coveted prize of any show; the herd consists of one bull, two yearling heifers and two heifer calves, all bred and exhibited by owner

sibly this migration occurred before other animals had as yet been domesticated, certainly no others were brought over. A considerable degree of civilization was acquired by man in the American hemisphere quite independently of the development of civilization in the Old World, but all the many food plants cultivated here by the natives, as well as their few domestic animals (except the dog), were indigenous. The cultivated food plants of American origin include many of the world's best, such as maize and potatoes, but the domestic animals are of little consequence, including only the llama, alpaca and guinea-pig. That man in America developed so many good food plants but such unimportant domestic animals shows that the available material in one case was excellent, but in the other case was poor. Conversely the pre-eminent success of man in central Asia in securing what are still our best domestic animals shows what paleontology confirms, that herbivorous animals suitable for easy domestication were abundant in the early home of man and were in fact early domesticated. They have been much modified subsequently and many diverse breeds have been produced in consequence of the supervision which man exercised over their racial evolution. The study of breeds of domestic animals afforded to Darwin some of the most convincing evidence for his theory of organic evolution by descent with modification from simpler and less specialized ancestors. As compared with their wild ancestors, domestic animals have undergone modification through the agency of selection, sometimes exercised consciously and with the definite end in view of perpetuating new and useful variations, sometimes obtained incidentally and without set purpose. Conscious selection for breeding purposes of the most docile individuals and of those which were strong and vigorous has in general given to domestic animals tameness and docility, making them easy of management. It has also given them early maturity which is usually accompanied with fecundity. Unconscious or natural selection would also favor variations toward early maturity and fecundity, since such variants in a mixed herd would naturally leave most offspring. Indirect effects of increased tameness and gentleness are greater and more economical consumption of food and more ready fattening, with decline in intelligence unless specially selected for as in the case of the dog and the saddle horse. Products of special utility have by selection been greatly improved or intensified and thus breeds kept for special purposes have originated. Examples are seen in the great milk production of dairy cattle and milch goats; of wool production in sheep and the alpaca, of meat production in pigs, mutton sheep and beef cattle. Under the guiding influence of selection continued through untold centuries breeds of domestic animals have become machines of the greatest efficiency for the production in maximum quantity of a specialized product of supreme quality. No more convincing evidence can be produced of the effectiveness of selection in guiding evolution in useful directions than is afforded by a study of breeds of domestic animals.

Present Day Methods.—The method of the present day breeder is that of all his predecessors who more or less consciously and intelligently have worked for the improvement of domestic animals. The method is to select in each generation and to rear offspring from those animals which are best suited to the special purpose for which the breed is kept, be it milk, meat, wool, work or what not. Thus breeds for special purposes are created and further improved. But the work of the animal breeder is less simple than this statement might seem to imply, since in the production of a new generation of animals *two* parents are involved, each of which influences the character of the offspring. Each selection of animals for propagation thus involves a double selection, selection of a sire and selection of a dam, and it is not sufficient that each be excellent for its kind. The two must be compatible in the inherited traits which they transmit. Otherwise undesirable combinations of characters may be obtained in the offspring, or a lack of the desired uniformity in different individuals.

The breeder's first principle of success is accordingly (1) *Select the best individuals to breed from.* His second principle is (2) *Mate each selected animal with one having compatible characters.* This in general will mean the mating of like with like, selecting mates only within the same established breed or sub-breed. But here comes in a danger which must be avoided. If animals most like each other in inherited traits are mated together, brother will be mated with sister, or cousin with cousin. But age-long experience shows that such matings very often result in diminished vigor, size or fecundity and so the careful breeder is reluctant to resort to close inbreeding, and if he does so occasionally in order to secure or preserve some particularly desirable combination of characters, he takes special precautions to avoid enfeebling effects. The breeder's third principle is accordingly (3) *Avoid close inbreeding.* No one can tell in advance to what extent inbreeding may safely be followed in a particular case. Miss King, experimenting with rats, has found it possible, by selecting in each generation only the most vigorous individuals to breed from, to continue mating brother with sister for more than 20 generations, without loss of vigor or fecundity in the race. On the other hand, rats inbred without such selection for vigor as was made by Miss King show marked loss of vigor and fecundity after 10 or 15 generations. He who resorts to inbreeding should do so with caution, keeping careful watch of the size and vigor of his race. Crossbreeding, i.e., the mating together of unrelated individuals, or those of very different inherited characters, has an effect on vigor contrary to that of inbreeding. It increases size and vigor and induces rapid growth. This is an important principle utilized by animal breeders in meat production among cattle, sheep and pigs. Distinct breeds are crossed, such as short-horn and Angus cattle, or Berkshire and Duroc-Jersey pigs. The result is to produce an animal superior to either pure breed as regards rapid growth and early maturity. But this superiority persists for a single generation only, so that the production of a second generation from the vigorous cross-breeds is not to be recommended. Lack of uniformity both in vigor and in other characters is quite sure to occur in the second generation, though not in the first. A fourth maxim for the breeder would be (4) *Employ crossbreeding whenever practicable, to increase vigor, but do not go beyond the first cross.*

While the variable second crossbred generation is of little use to the ordinary breeder, it may be of great value to the experimental breeder, who is engaged not in mere quantity production of a standard type of animal, as the ordinary breeder is, but in the attempt to produce a new type of animal better suited for some special purpose than are existing types. The experimental breeder works by the method of crossing two breeds, each of which contains a different inherited character or set of characters, which he desires to combine in one new race. Crossbreeding is the only method by which characters found in different races may be combined in a single new race. Seldom is the desired combination secured in the first crossbred generation. More often it will only be found in a small percentage of the second generation crossbreds obtained by breeding first generation crossbreds with each other. Such animals of the second generation crossbreds as do present the desired combination of characters may now be mated with each other and a new race of the desired type may thus be secured. But at first it is apt to be rather variable and several additional generations of selection are usually required fully to establish the new type. The production of a new breed is thus a difficult and expensive undertaking and should be tried only by experts familiar with the method of inheritance of different characteristics.

The fundamental law of inheritance which underlies character recombination in new breeds, and to which also established breeds owe their uniformity, is known as Mendel's law (q.v.). This is the law of unit character inheritance, in accordance with which the different inherited characters are found to behave like independent units in transmission and so can be rearranged in new combinations. Each individual of an established breed of animals transmits a certain assemblage of inheritance units, which constitute the breed characteristics. So long as matings are made only within the breed all the progeny have these same inherited breed characteristics, such as black color and hornlessness in the case of Aberdeen-Angus cattle, red color and hornlessness in the case of Red Polled cattle, red color and horns in the case of Devon cattle, and white face and horns in the case of Hereford cattle.

But if we cross a breed of black cattle with a breed of red cattle, the first generation offspring will be black, the color unit black being stronger than the color unit red. We call black the *dominant* unit of the two, and red the *recessive* unit. But the black crossbreds have inherited red no less than black, even though they do not show it, and they will transmit it to half their progeny the alternative with black being transmitted to the other half of the progeny. Accordingly if a crossbred black bull is mated with red cows, we find that on the average half the calves are black in color and half are red. This comes about as follows: The crossbred bull transmits the black unit to half his calves. This unit meets a red unit transmitted by the red dam and dominates it producing a black calf. To the remaining calves, half of the total, the bull transmits the red unit which meets a red unit transmitted by the red dam and thus produces a pure red combination. Such reds will breed true because they contain *only the red unit*. But the blacks which contain also a red unit will not breed true. Nevertheless true breeding blacks may be obtained even from crossbreds, by mating black with black. If the crossbred black bull were mated with pure black cows, half his calves would be pure blacks, viz., those to which he transmitted the black unit, for to all the calves in such matings the black dam would transmit the black unit. If the crossbred bull were mated with crossbred cows, one-fourth of the calves would be pure blacks, two-fourths would be impure blacks (not true breeding) and one-fourth would be pure reds. For each parent would transmit impartially either the black or the red unit and the expected combinations would be:

Units transmitted by sire,	B or R		
Units transmitted by dam,	B or R		
Combinations..........	BB,	BR, BR,	R R
	Pure black	Impure black	Pure Red

If the two breeds of cattle which we crossed were Aberdeen-Angus and Red Polled, all the cross-bred calves would be polled, since both breeds possess this same unit. But if we crossed Aberdeen-Angus cattle, which are black and polled, with Devon cattle, which are red but have horns, we should get a different result, viz., imperfectly developed horns (scurs) in the crossbreeds, which would all be black. A crossbred bull of this sort would transmit to half his calves the polled condition and to half he would transmit horns. To half he would transmit black color and to half he would transmit red color. But horns and color are distinct units in heredity, hence the *combinations* of units which a crossbred of this sort might transmit would be of four sorts, viz., polled black, polled red, horned black and horned red. In fact animals presenting these four sorts of combinations would be obtained in the second generation of crossbreds produced by mating first generation crossbreds with each other. This case illustrates how the principle of unit character inheritance may be utilized to secure new combinations of inheritance units in which breeds differ. The maximum number of recombinations may be obtained in the *second* crossbred, not the first crossbred, generation. This principle has undoubtedly been utilized, consciously or unconsciously, in producing existing breeds and can be used more freely in the future because its operations are now better understood. Nevertheless the crossing of breeds is something which should be undertaken cautiously, for it will be found that few cases are as simple as the hypothetical one just discussed. Most breeds differ by a great many unit characters and a cross in such cases produces an extremely variable second generation, because of the large number of recombinations of characters which will be obtained, and few of these recombinations, even if desirable, can be isolated in true breeding types without subsequent selection through several generations.

Moreover most inherited characters are not simple (behaving as single units) but complex, depending upon the simultaneous presence of several or many independent units. This makes their manipulation in crosses extremely difficult. Differences in size, early maturity and productiveness are among the most valued economic characters of breeds, yet these in no case behave as simple units in transmission. They commonly behave neither as dominant nor as recessive units but yield intermediates or blends. A second crossbred generation again yields blends but with increased variability, giving indications of segregation more or less complete. This is interpreted as meaning that many distinct units are involved which segregate and recombine independently of each other. In such cases crosses are useful only if the production of intermediates is desired. If it is desired to extend the range of existing variation in quantitative characters, it is better not to cross breeds, but to practise systematic selection in the desired direction within the breed which most nearly approaches the ideal. For example, suppose increased quantity production of milk is desired in cattle. The most productive of existing breeds is admitted to be the Holstein-Friesian. If this breed is crossed with a less productive breed, the offspring are found to be of intermediate productiveness. Such a cross would not be a promising means of obtaining productiveness greater than that of the Holstein-Friesian. It would be better to search within the breed for families of unusual productiveness and try further to improve these best families by selection, avoiding close inbreeding however by mating with each other representatives of different families of great excellence. This is the practise now followed by the best informed breeders. Still there are conditions under which crossbreeding, even of Holstein-Friesian cattle, may be desirable. Holstein milk contains too little butter fat to satisfy some markets. Improvement in its quality may be secured by a cross with dairy breeds which produce richer milk, though less of it, as is true of Guernseys and Jerseys. Whether the improvement in quality thus secured will offset the diminished quantity production entailed by the cross and the undesirable variability of the later crossbred generations is a matter for experimental determination.

A fifth maxim for the breeder may now be formulated. (5) *Both the uniform excellence of established breeds and the making of new breeds with novel combinations of characters depend upon Mendel's law of unit character inheritance. The breeder should be thoroughly familiar with the workings of this fundamental law.*

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STOCK-DOVE, a wild European pigeon (*Columba œnas*), about 13 inches in length, and with a general bluish-gray plumage, the breast being purplish. It raises two or three broods in a season and builds its nest in the hole of a tree, in a rabbit-burrow or some similar place. See Pigeon.

STOCK EXCHANGE. See Exchange.

STOCK JOBBING. See Exchange.

STOCK RAISING. See Cattle; Stock Breeding.

STOCK YARD. See Abattoir; Meat Packing; Meats and Meat Product.

STOCKADE, (1) *In civil engineering* a row of piles, or a series of rows, driven into a sea or river shore, to prevent the erosion of the banks. (2) *In fortification,* stout timbers planted in the ground so as to touch each other and loop-holed for musketry. In its most effective form it is eight or nine feet high, has a ditch in front and a banquette in the rear. The stockade is a very old form of fortification. See Fortifications.

STOCKBRIDGE, Henry, American lawyer; b. North Hadley, Mass., 31 Aug. 1822; d. Baltimore, Md., 11 March 1895. He was graduated at Amherst College in 1845 and was admitted to the bar in 1848. He was a special district attorney in the service of the War Department of the United States in the Civil War; and in 1864 was a member of the Maryland legislature, where he introduced the bill which resulted in convening a constitutional convention and the abolition of slavery in the State. Later he successfully combated in the United States courts the indentures of apprenticeship through which emancipation was being evaded. He was for more than 20 years vice-president of the Maryland Historical Society and editor of its fund publications. Author of 'Archives of Maryland' (1886).

STOCKBRIDGE, stŏk'brĭj, Mass., town, Berkshire County, on the Housatonic River, and on the New York, New Haven and Hartford Railroad, 15 miles south of Pittsfield. The town includes the villages of Stockbridge, West Stockbridge, Centre, Curtisville and Glendale. In 1736 the Stockbridge Indian mission was moved here from Great Barrington, and under the influence of this mission the Indians were civilized and Christianized, so that, in 1739, when the town was incorporated they were given full privileges of citizenship. In 1751 Jonathan Edwards became pastor of the church. After the Revolutionary War the Indians moved west, finally settling in Kansas. The town is situated in the midst of picturesque mountain scenery, and contains many handsome summer residences. It has a number of mills, including woolen, paper, grist and saw mills; and a national bank, a public high school founded in 1868 and a public library, founded in 1862. Pop. about 2,000. Consult Jones, 'Stockbridge Past and Present.'

STÖCKER, stĕk'ĕr, **Adolf,** German theologian and social reformer: b. Halberstadt, 11 Dec. 1835; d. 1909. After studying theology and philology in Halle and Berlin, he was made pastor at Seggerde (1863) and eventually court and cathedral preacher at Berlin. His importance is owing to the fact that in opposition to the Social-Democrats he founded, in 1877, a Christian Socialistic party. This new association won numerous adherents in only a few places, but the idea of Christian Socialism has been widely accepted by a large number of religious teachers. In his fiery zeal and activity against his opponents he was particularly violent in his treatment of the Jews, and he thus hindered the practical success of his theory. In 1880 he was elected to the Reichstag and allied himself with the extreme conservatives. But his socialistic activity, by which he was led more and more to take the attitude of reforming agitator, displeased the government and in 1890 he was dismissed from his office of court-preacher. He was president of the Berlin City Mission; Member of the Upper Synod; and in 1892 became editor of the ‘Deutsche Evangelische Kirchenzeitung.’ He is the author of a volume of ‘Sermons for the People’ as well as of ‘Speeches.’ He has also published many Socialistic tracts and an autobiography.

STOCKHOLDER. A stockholder is one who owns stock in a corporation or joint stock company, and who has been vested with certain rights and liabilities by law, by virtue of his relation to other owners of stock and to creditors of the corporation. The term shareholder is used commonly interchangeably with stockholder. When a corporation is formed and the books of the company are opened, individuals subscribe for stock or shares in the company and certificates are issued to them as evidence of their right in the company which is granted by virtue of the sale of stock, the certificates of stock being merely the evidence of the transaction. Loss of certificates, or the fact of their not being issued cannot relieve the owner of stock of his rights, or of his liabilities. Although stock may be paid for in services, or good will, or patents, or property, as well as in money or negotiable paper, the stockholders as soon as they acquire membership in the corporation stand on the same footing, and have equal privileges. The number of shares owned regulates the proportion of interest to be drawn by the individual, and the voting power in the affairs of the company. Any person who has legal capacity to own personal property may be a stockholder, and municipal and private corporations may be stockholders in other corporations within limitations contained in their incorporation. A manufacturing corporation may not subscribe to the stock of a bank or of a railroad, but may in payment of a debt, take stock in such other corporation, and may hold it and enjoy the same rights as other stockholders. The rights of all stockholders are represented by the corporate management, usually a board of directors. Legal relation between the corporate management and the shareholders is created by subscribing to, or contributing for shares of stock. The stockholder relies entirely upon the charter of the corporation as to his contract, regardless of representations of an agent, and an alteration in the constitution effecting a radical change in the corporate enterprise releases a shareholder from his subscription. A corporation has the right, through its management, to carry on the corporate enterprise as against all persons including a minority of the shareholders, in a manner and for the purposes set forth in its constitution. The board of directors can be controlled only by action of a majority of shareholders. It is understood that the majority of shareholders shall govern in all matters coming within the act of corporation, and all shareholders are bound by the acts of the majority represented by the management. The individual shareholder has only that control of the affairs of the corporation which his vote represents at the meetings of shareholders. If it may be shown that any act of the corporation will benefit a majority of shareholders, one shareholder or a minority, may not interfere, because the act may be an injury to him. But a minority may prevent by law any use of the funds of the corporation which are not strictly within the charter, or which may be shown as detrimental to the majority. Shares of stock give the holder a fixed right in the division of the profits or earnings of the company so long as it exists, and of its effects when dissolved. At corporate meetings each shareholder has a right to vote, and this cannot be taken from him. The right to vote by proxy does not exist unless so stated in the constitution of the company. Each holder has the right to inspect the company books either personally or through a representative or attorney.

It is supposed that stock is paid for at par and that the number of shares sold represents the working capital of the corporation. A creditor may enforce his right to have the nominal value of capital stock paid in, even to making the directors call upon the stockholders to pay a pro rata share on their stock. The liability of a stockholder for the debts of the company is fixed by statute and differs in the various States. In some States a stockholder can be held for a sum equal to his subscription; special liabilities which make the stockholder responsible for other amounts or for particular debts, also exist under the laws of some of the States. Regarding the liability of shareholders in a national bank, it has been held that the shareholders are individually responsible, equally and ratably, and not one for another, for all contracts, engagements and debts of such association to the extent of the amount of their stock therein, at the par value thereof, in addition to the amount invested in the shares.

Irregular or fraudulent transfers may be set aside if it can be shown that there was intention to escape liability to the detriment of creditors.

A subscriber to stock is presupposed to know the obligations assumed and ignorance will not excuse him from liability to creditors. See Corporations, History of; Stock; Exchange.

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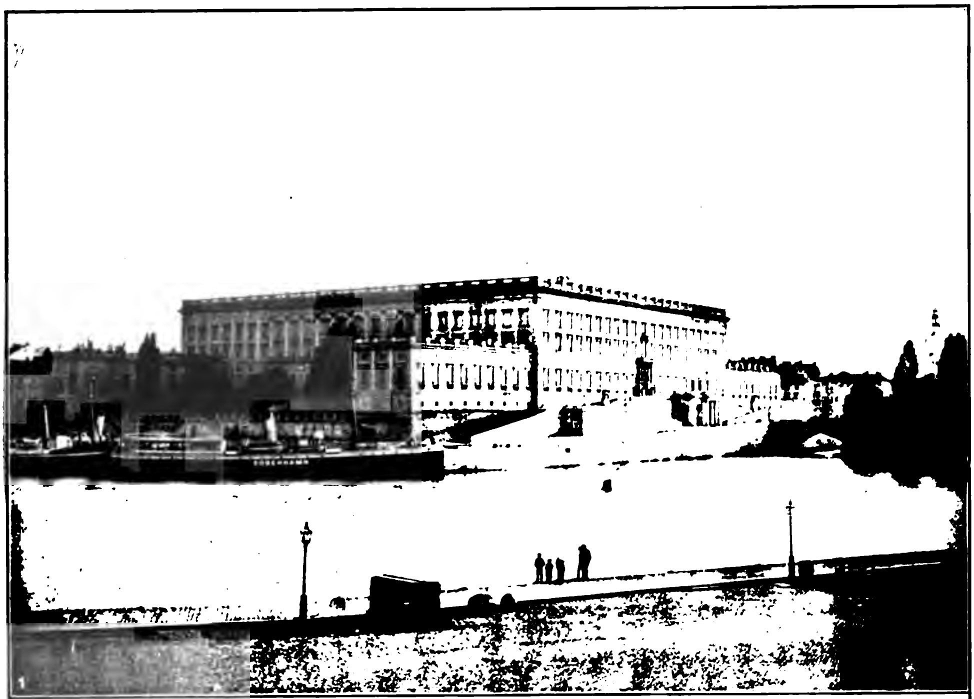
STOCKHOLM, stŏk'hōlm, capital of Sweden, situated on the Mälar See (Lake Mälar), 440 miles southwest of Saint Petersburg. It is on a cluster of islands, connected with the mainland by bridges, chief of which are the Norrbro and Vasabro, joining the stadtin or city with the north side of the strait. The city, without its northern accessories, might impress one as another Venice, especially



1 The Royal Palace, Stockholm

2 General view of Stockholm

in approaching it from the Baltic or from Moseback Hill. Yet it surpasses in natural attractions the Venetian city. The largest island is Gustavsholm, containing the city proper; and with the islands of Riddarsholm and Helgeandsholm, is the oldest section. Its antiquity and irregularity render this part most interesting. Other islands contain the modern-constructed town. The houses are frequently coated with stucco in light colors or white. The buildings of note are the palace of the 17th century, with Corinthian pillars adorning the façade, and an edifice of symmetrical proportions. The National Museum, the Northern Museum, the Riddarhus (Knight's house) and several churches. The oldest church is Saint Nicholas (1264), in which Swedish sovereigns are crowned; the Riddarsholm Kyrka, contains the remains of a long line of kings and has other historical interest. In Normalm is the church of Adolphus Frederick and the National Library, containing 250,000 books, and 8,000 manuscripts. On the northern mainland stands the National Museum, a fine Renaissance edifice, which contains many antiquities, coins, drawings, engravings, etc. There are, too, the governor's house, facing the quay where an obelisk commemorates Gustavus III; the Ridderhus or Senate Chamber; the Rigsdagshus or House of Parliament; exchange, mint, town-house, with courts of law; ethnographical museum with numerous Scandinavian antiquities; theatres, opera-house, arsenal and barracks. There is a medical college, technological institute, navigation school, school of design, also benevolent institutions and other educational establishments; literary, scientific and artistic associations, etc. Chief among the latter are the Swedish Academy, Academy of Sciences, celebrated by the name of Berzelius; musical academy; medical, horticultural and agricultural societies. Ship-Island, east of the city island, is headquarters of the Swedish navy, and contains ship-building yards and marine repair-shops. Farther east are the islands containing the zoological gardens. All the islands have communication with each other by bridges, tramways and steamboats. The recreation grounds and promenades are attractive, especially Djurgården, Haga Park and Carlberg. The city's manufactures are chiefly textiles, porcelain, pottery, sugar, tobacco, cotton, ironware, beer, soap, food products and machinery. Trade is considerable, Stockholm, being the largest Swedish industrial and commercial centre and its most important port of entry, and the principal exports are: iron, copper, tar and timber. The imports: colonial produce, wine, salt, fruit, etc. The shipping of Stockholm is second highest in the kingdom and shipbuilding is one of the industries of the city. There were, in 1908, 249 vessels engaged, with a total tonnage of 124,037. Stockholm was founded in 1260. Subsequently fortified, it withstood several memorable sieges. Pop. about 400,000.

STOCKHOLM, Bank of. As this was the earliest bank to issue circulating notes, an outline of its history can scarcely fail to prove of practical value. After the death of Gustavus Vasa his daughter, the Regent Christina, 1632–45, was compelled by the embarrassments of the treasury to issue a sort of exchequer-bill, which appears to have had a somewhat slow and grudging circulation as money. Ten years later the treasury, still embarrassed, adopted the suggestions of a financier named Palmstruck and established a bank at Stockholm in 1656, which invited deposits of coins, bullion and runstyks, for which it granted transferable credits on its books in «Bank-money»; an expedient which met the approval of the commercial community. In 1658 the bank began to issue «transport-notes» which being more convenient than copper runstyks soon drove the latter into the bank, which now being upon an avowedly copper basis, began to lose credit as bullion copper fell in value and the copper plates to support the transport-notes became too heavy for convenient circulation. In this dilemma Baron George Heinrich de Goertz, the king's financial adviser, closed the mints to the «free coinage» of copper and issued light copper dalers (dollars) instead. But the government was too weak to sustain a fiduciary currency; the pieces were too inartistic to defy counterfeiting, and there was no fixed limit to their emission, three cardinal requirements of such a currency, especially the third one. The inevitable consequence was a ruinous fall in their value, a rise of popular indignation against Baron Goertz, his impeachment, trial, condemnation and unjust execution 3 March 1719.' The bank (Rigsbank) is still in existence. (Consult 'History of Monetary Systems,' 298). For list of other ancient banks see list under the heading BANKS AND BANKING.

STOCKING, a covering for the foot and leg, knitted or woven either from cotton, woolen or silk thread. The stocking is made usually only of one thread entwined so as to form a species of tissue, extremely elastic, which readily adapts itself to the part it is intended to cover. The tissue differs from cloth in having neither warp nor woof, but approaches it closely, and is much superior for the purposes to which it is applied. The ancients wore no particular covering for the legs, but during the Middle Ages, hose or leggings of cloth came into use; and at a later period the art of knitting stockings was invented, according to some authorities by the Spaniards, while some attribute it to the Scots. In 1589 William Lee of Nottinghamshire, England, invented the stocking-frame, a machine for weaving stockings which was in use and scarcely improved upon for nearly two centuries. Lee met with little encouragement in his attempts to set up an establishment in England and went to France where he was received with great favor by Henry IV. The monarch's assassination soon after, however, interrupted his prospects and he died in Paris in great poverty. A knowledge of his machine was carried back to England by some of his workmen who established themselves in Nottingham, which has since remained the principal seat of the English hoisery manufacture. For the stocking-frame and improvements in stocking machinery, and for modern methods of manufacture, see HOSIERY AND KNIT GOODS INDUSTRIES IN THE UNITED STATES.

STOCKPORT, stŏk'pôrt, England, in the counties of Cheshire and Lancashire, on the Mersey River, five miles southeast of Manchester. It stands upon an elevation, in terraces, is irregularly built, but highly picturesque.

There are churches of various denominations, the chief of which are Saint Mary's, Saint Thomas', Saint George's, Saint Peter's, Saint Paul's and Christ Church. Other noteworthy buildings are the Mechanics' Institute, market-hall, free library, technical and grammar schools and infirmary. The museum is situated in Vernon Park, one of the several recreation grounds of the city. The railway viaduct on the London and North-Western Railroad is of fine proportions and spans a great part of the town. The staple manufacture is cotton. There are numerous factories and industrial works, including print, dye and bleach works, and extensive hat factories, iron and brass foundries, breweries and brickyards. The city owns the street railway, electric-light plant, markets, gas, water-power and sewage works. Pop. about 110,000.

STOCKS, a wooden apparatus to put the legs of offenders in, formerly used for the restraining of disorderly persons, or as a punishment for certain offenses.

STOCKTON, Charles G., American physician: b. Madison, Ohio, 27 Aug. 1853. He was graduated in medicine at Buffalo University in 1878. He was professor of materia medica and therapeutics at Niagara University in 1885–87; and has been professor of medicine and clinical medicine at Buffalo University since 1887. He is attending physician at the Buffalo General Hospital; and consulting physician at the New York State Hospital for Crippled and Deformed Children. He has contributed to various medical compilations and encyclopedias, and is author of 'Diseases of the Stomach.'

STOCKTON, Charles Herbert, American rear-admiral: b. Philadelphia, Pa., 13 Oct. 1845. He was graduated at the United States Naval Academy in 1865, first having seen active service in the Civil War on the *Macedonian*. He was promoted commander in 1892, captain in 1899 and rear-admiral in 1906. He commanded the *Yorktown* in 1895–97; was president of the Naval War College in 1898–1900; commanded the *Kentucky* in 1901–03; was naval attaché at the American embassy, London, in 1903–05; and commanded the Special Service squadron visiting Bordeaux, France, for the maritime exposition in 1907. He was retired in 1907. He was president of the George Washington University in 1911–13; and was the first United States delegate to the London Naval Conference in 1908–09. He has written extensively on international law and besides numerous papers is author of 'A Manual of International Law' (1911); 'Outlines of International Law' (1914), etc.

STOCKTON, stŏk'tŏn, **Francis Richard**, (Frank R. Stockton), American author: b. Philadelphia, Pa., 5 April 1834; d. Washington, D. C., 20 April 1902. After a secondary education in Philadelphia, he became a wood-engraver, practised the art with some success, and invented a double graver (1866). In 1872 he entered journalism, joining the staff of the Philadelphia *Post*, in the same year that of *Hearth and Home* of New York, somewhat later that of *Scribner's Monthly*, and in 1874 that of *St. Nicholas*, of which he was assistant editor until 1882. During this period he wrote many stories for children, among which were 'Roundabout Rambles' (1872); 'What Might Have Been Expected' (1874); 'Tales Out of School' (1875); 'A Jolly Fellowship' (1880); 'The Floating Prince' (1881); 'The Story of Viteau' (1884) and 'Personally Conducted' (1889). His first success was made with 'Rudder Grange' (1879), a burlesque account of a house-boat outing, and this he followed by the now well-known series of quaint and whimsical volumes which have made Stocktonian humor a thing peculiar to itself. Much of his best work is to be found in his short stories, the best known of which is probably 'The Lady or the Tiger.' He was a prolific writer of novels, short stories, sketches and tales for children. Much of his humor depends upon the situation in which his characters are placed and the grotesque attitude of the author toward them; yet Stockton created many delightful characters that, with all their whimsicality, are quite human and very likeable personages. The list of his published works includes 'The Casting Away of Mrs. Lecks and Mrs. Aleshine' (1886); 'The Late Mrs. Null' (1886); 'The Christmas Wreck' (1886); 'The Bee Man of Orn' (1887); 'The Dusantes' (1888); 'Amos Kilbright' (1888); 'The Great War Syndicate' (1889); 'The Squirrel Inn' (1890); 'Ardis Claverden' (1890); 'The Watchmaker's Wife' (1893); 'The Adventures of Captain Horn' (1895); 'The Girl at Cobhurst' (1897); 'A Story Teller's Pack' (1897); 'The Associate Hermits' (1898); 'Afield and Afloat' (1900); 'A Bicycle of Cathay' (1900); 'John Gayther's Garden, and the Stories Told Therein' (1902) and 'The Captain's Toll-Gate' (1903). See CASTING AWAY OF MRS. LECKS AND MRS. ALESHINE; RUDDER GRANGE.

STOCKTON, Richard, American statesman: b. near Princeton, N. J., 1 Oct. 1730; d. there, 28 Feb. 1781. He was graduated from the college of New Jersey, at Newark, in 1748, studied law, was admitted to the bar in 1754 and rose rapidly to the first rank as a lawyer. In 1776 he visited England. He was made a member of the executive council of New Jersey in 1768 and in 1774 was appointed a judge of the Supreme Court. In 1776 he was elected to Congress and, though at first doubtful of its policy, cordially supported the Declaration of Independence. In the same year he served on the committee appointed to inspect the northern army and report its state to Congress. After his return to New Jersey was captured by the British and confined in the common prison at New York. The unusual severity with which he was treated there broke his strength and eventually caused his death. Consult Sanderson, J., 'Biography of the Signers of the Declaration of Independence' (Philadelphia 1847).

STOCKTON, Robert Field, American naval officer and politician: b. Princeton, N. J., 20 Aug. 1795; d. there, 7 Oct. 1866. He served in the War of 1812 and in the Algerian war 1814–15. In 1821 he commanded the *Erie* on a cruise to Africa, where he secured the territory which now forms the present Liberian republic; and in the autumn of the same year he was instrumental in the suppression of pirates and slavers in the West Indies. He strongly advocated a steam navy and drew the plans for the sloop of war *Princeton* on which an exploding gun killed the secretaries of war and the navy in 1844. He was commander of the Pacific squadron during the Mexican War, when he took possession of California in the name of the United States, capturing Los Angeles and San Diego and establishing civil government on the coast. After his resignation from the navy in 1850 he devoted himself to politics and in 1851 was elected to the United States Senate, where he introduced a bill, subsequently passed, abolishing flogging in the navy. On leaving the Senate in 1853 he turned his attention to the improvement of the Delaware and Raritan Canal, an enterprise he had previously encouraged. Consult ‘Life and Speeches of Robert Field Stockton’ (Philadelphia 1856).

STOCKTON, Thomas Hewlings, American Methodist Protestant clergyman, half-brother of F. R. Stockton (q.v.): b. Mount Holly, N. J., 4 June 1808; d. Philadelphia, Pa., 9 Oct. 1868. He began the study of medicine but in 1829 entered the ministry of the Methodist Protestant Church. He was chaplain to the House of Representatives in 1833–35 and in 1859–61. He had charge of churches at Philadelphia in 1838–47; at Cincinnati in 1847–50: at Baltimore in 1850–56; and again at Philadelphia in 1856–68. He was a pioneer in anti-slavery agitation, an opponent of sectarianism and was famous for his eloquence. He compiled a hymnbook for the use of his denomination, and was author of ‘Sermons for the People’ (1854); ‘Poems, with Autobiographic and other Notes’ (1862); ‘The Book Above All’ (1870), etc.

STOCKTON, Cal., city, the metropolis and chief distributing centre of the San Joaquin Valley, county-seat of San Joaquin County; 78 miles east of San Francisco and 397 miles northwest of Los Angeles.

Transportation and Commerce.— Stockton is favorably situated to command the trade of the San Joaquin Valley and of the mining and lumbering districts along the eastern rim of the valley. The main lines of the Atchison, Topeka and Santa Fé and the Western Pacific and two lines of the Southern Pacific run through Stockton, connecting it with San Francisco and its bay region, the San Joaquin Valley to the south, the Sacramento Valley to the north and eastern points. Branch lines of the Southern Pacific extend from Stockton to the mining regions on the Mother Lode and the lumbering districts of the Sierra. One hundred and seventeen passenger trains daily enter and depart from Stockton. The Yosemite Valley, the Tuolumne Grove of Big Trees, the Calaveras Big Trees, Mercer's Cave and Lake Tahoe are readily reached by automobile from Stockton; Yosemite Valley and Lake Tahoe also being connected by rail. The city is at the head of all-the-year navigation on the San Joaquin River system, being connected to the river by a navigable channel two and one-half miles in length. To San Francisco by water is 94 miles and daily steamer service is maintained. The leading articles, in the order of their valuation, are general merchandise, millstuffs and grain, potatoes, barley, beans, vegetables, wheat, horses, sheep, vehicles, lumber, onions, fuel oil, machinery and canned goods. Since the beginning of the grain industry of California, Stockton has been the principal grain market of the great central valley. The 14 grain and produce warehouses of Stockton have an aggregate capacity of 165,000 tons and there are another 10 warehouses in the outside districts which bring the aggregate storage capacity up to 200,000 tons. All of the local warehouses are conveniently located to handle shipments by both rail and water. Grain is transported from Stockton to ocean vessels in San Francisco Bay for 65 cents per ton. Forty-nine commodities are shipped annually from Stockton in carload lots, the most important being agricultural implements, grain, beans, engines, flour and millstuffs, hay, livestock, onions, potatoes, wine, brandy, grapes, fruits and leather.

Manufactures.— Abundance of raw material, cheapness of power, low transportation rates and location as a distributing centre have developed the manufacturing interests of the city, and there are 157 manufacturing establishments in Stockton, with an annual output valued at $11,293,000. Fuel oil from the upper San Joaquin Valley is the most common source of power. With fuel oil at recent current prices, power can be generated in Stockton as low as one-half of a cent per horse-power per hour. Electricity, coal and gas are also used as sources of power. From the source of power on the Mokelumne River, 45 miles distant, a line with the capacity of 30,000 horse-power delivers electricity in Stockton for lighting and manufacturing purposes. A second line of the capacity of 6,000 horse-power extends from the south fork of the American River to Stockton, a distance of 80 miles. Fourteen natural gas wells, varying in depth from 1,800 to 3,000 feet, supply gas for home and factory use. This city is the centre of the flour, cereal, poultry and dairy feed industry of the State. The mills have a daily capacity of 2,000 barrels of flour, 1,500 barrels of cereals, 100 tons of poultry and dairy foods and 600 tons of by-product foods. Large export shipments are made to the Orient, Europe, Alaska, Central and South America and the Southeastern States. “Caterpillar” and “sieve-grip” traction engines, combined harvesters, rice harvesters, seed cleaners, pumps, plows, harrows, scrapers and other agricultural machines and implements are manufactured in Stockton. Stockton has the largest traction engine plant west of the Mississippi River and its product is shipped to every country in the world. This combined harvester factory covers approximately nine acres and is the largest of its kind in the world. This type of machine combines header and threshing machine, cutting, threshing and sacking the grain by continuous process. The so-called “tanks,” used with such effectiveness by the British army in the European War, were nothing more than armored Stockton “caterpillar” tractors. Notable among Stockton manufactures is the bean threshing machine that performs every operation from threshing to recleaning the beans. Stockton contains the only window glass factory west of the Mississippi. Dredges and ditch digging machinery, which have played so important a part in the reclamation and irrigation of the San Joaquin delta, are manufactured in Stockton. Stockton contains one of the four electrical steel furnaces west of Chicago. Machine works and foundries supply machinery and castings throughout the Pacific

Coast. A large cannery uses a substantial part of the output of the numerous orchards and truck gardens near the city. Other important manufactures are sole, harness and other leathers, paper, scoured wool, boats and barges of varied descriptions, paving machinery, common and fire brick, engines (marine, gas, gasoline, distillate and crude oil), ice, beer, wine, brandy, olive oil, butter, insect powder (Buhach), macaroni, pumps, windmills, wagons, gloves, soap, paint, jewelry, soda water, medicines, cigars and bread and candy for a large territory.

Municipal Facilities.— Stockton is an attractive, modern city, having 12 public parks, including one of 27 acres at the northwest corner of the city, a good electric car system, and 190 miles of streets of which 32 miles are paved with asphalt and 53 miles with miscellaneous pavements, principally asphalt bound macadam. There are in Stockton two large public baths supplied by warm artesian water, a park with picnic grounds and a baseball diamond. Stockton Channel, the San Joaquin River and Lake Yosemite also afford opportunities for swimming as well as rowing and other water sports. Stockton is one of the best shaded cities in California, the most popular trees along the streets and in the gardens being the elm, the maple, the acacia, the orange, the palm, the oleander and the umbrella tree. From 27 wells, varying in diameter from 12 to 20 inches, and in depth from 250 to 1,100 feet, water is pumped direct into the city mains, against a head of 110 feet above the ground level, using a 200,000 gallon steel tank at that elevation for balancing. These 27 wells are located at three separate stations about two miles apart. Twenty of them are located on a 10-acre tract and supply from 8,000,000 to 10,000,000 gallons daily, without showing any diminuation of their capacity. The water system is owned by a private corporation. Rates are regulated by the Railroad Commission of California.

The city has a fully-paid and well-equipped fire department with 38 men. The police department has 36 men. A post-office of the first class, has an annual revenue of about $150,000, 65 employes and 7 rural delivery routes, one of which, serving the delta, is a water route, of which there are only three or four in the United States, delivery being made by launch. There are about 7,500 telephones connecting at Stockton, including 265 reaching nearby farming districts; 36 church organizations and 26 buildings used for religious purposes; 15 public schools valued at $752,600 and enrolling about 4,200 pupils, the high school group of buildings, including the science, manual arts and gymnasium buildings, costing $206,000; 2 parish schools, including Saint Agnes College; a business college, a normal school and a number of smaller private schools and academies. The public library cost $75,000 and has 70,000 volumes and 33,000 pamphlets, maps and atlases. It serves not only the people of Stockton but 26 deposit stations throughout San Joaquin County. There are 17 hotels, including the half-million dollar Mission hotel facing the plaza, built by the people of Stockton; the buildings of the State Hospital for the Insane; Saint Joseph's Home and Hospital; Young Men's Christian Association building; Elks' building; several bank buildings, the 10th story and roof of one of which is occupied by the chamber of commerce; three daily papers, one semi-weekly and five weekly papers are published in the city. The eight banks of Stockton have a paid-up capital of $2,802,700, with surplus, undivided and other profits of over $1,821,000; deposits amounting to over $20,661,000, including the circulating notes of national banks; loans over $17,644,000; and resources aggregating in excess of $25,285,000. There are three building and loan associations with assets of over $1,882,000. The assessed valuation of all property in the city proper is about $29,000,000; bonded indebtedness, $750,000.

History and Government.— In 1843, Capt. C. M. Weber, the founder of Stockton, secured a grant of 11 square leagues (48,747 acres) of land from the Mexican government. This grant known as the Campo de los Franceses included the site of the present city of Stockton. At first stock raising was the only industry. With the discovery of gold in 1848, Stockton became at once the most important supply station for the southern mines. At the head of navigation on the San Joaquin River, goods were brought on sailing vessels from San Francisco to Stockton, the nearest point to the mines. From Stockton supplies were sent to the miners by ox teams, by pack animals or in huge wagons known as "prairie schooners." As grain farming developed, the city naturally became the shipping point for the entire tributary region. The completion of the first overland railroad in 1869 greatly increased the importance of Stockton as a manufacturing and distributing centre. In 1850 Stockton was incorporated with a population of 2,000. The city's growth has been steady and substantial. Under the charter of 1911 the elective officers of the city are a mayor, four councilmen and 5 school directors, so classified that their terms do not expire coincidentally. They serve for four years. The council designates one councilman to be commissioner of finance, revenue and public supplies, who shall be ex-officio treasurer, one to be commissioner of public health and safety, one to be commissioner of public works and one to be commissioner of audit. The city was named in honor of Commodore Robert Field Stockton of the United States navy. It was laid out in blocks 303 feet square.

Population.—(1890) 14,424; (1901) 17,506; (1910) 23,253. A complete census of the city is taken each year by the school census marshals. In 1914 well-developed territory to the north, east and south was incorporated within the city limits. The population of the city and its immediate tributary territory is estimated at 52,219.

STOCKTON-ON-TEES, tēz, a seaport town in Durham, England, situated on the Tees River, 11 miles northeast of Darlington. The river is navigable for vessels of heavy draught. Stockton consists of two sections, the town proper and South Stockton of more recent date, connected by a fine modern bridge. It has municipal buildings, a custom-house, many good churches, quays and steam tramways. There is a fine race-course in the vicinity and Ropner Park, laid out in 1893. Shipbuilding is an extensive industry and there are important foundries, blast-furnaces, engine-works and potteries, breweries, corn and spinning-mills and factories for the making of sail cloth, ropes and linen. The exports include iron-ware and pottery; the imports are chiefly corn, timber, etc. There is quite a brisk river trade. The *Stockton* and *Darlington* were the first boats to carry passengers and goods. Pop. about 52,000.

STODDARD, stŏd'ard, **Amos,** American soldier: b. Woodbury, Conn., 26 Oct. 1762; d. Fort Meigs, Ohio, 11 May 1813. He served in the Revolutionary War and at its close practised law in Maine. He was governor of the Territory of Missouri, 1804–05, fought in the War of 1812 and was mortally wounded in the siege of Fort Meigs. He published ‘Sketches of Louisiana’ (1810), and several valuable historical papers.

STODDARD, Charles Augustus, American Presbyterian clergyman: b. Boston, 28 May 1833. He was graduated from Williams College in 1854; taught; traveled in Europe and the East; studied at the University of Edinburgh and the Free Church of Scotland Theological Seminary, and was graduated D.D., from Williams College 1871; Union Theological Seminary in New York in 1859. He was pastor in a Presbyterian church in New York, 1859–83; became associate editor of *The Observer* in 1869, part owner in 1872 and was owner and editor-in-chief, 1885–1902. His publications include ‘Across Russia from the Baltic to the Danube’ (1891); ‘Glimpses of Gibraltar and Tangier’ (1892); ‘A Spring Journey to California’ (1895); ‘The Centennial Celebration of Williams College.’

STODDARD, Charles Warren, American author: b. Rochester, N. Y., 7 Aug. 1843; d. 24 April 1909. He studied at the University of California and was for some time an actor and for seven years special traveling correspondent of the San Francisco *Chronicle,* visiting nearly every quarter of the globe and spending five years in the South Seas. From 1885 to 1887 he was professor of English literature at Notre Dame College, Indiana, and from 1889–1903 at the Catholic University of America. Among his publications are ‘Poems’ (1867); ‘South Sea Idylls’ (1873); ‘Summer Cruising in the South Seas’ (1874); ‘Mashallah’ (1880); ‘The Lepers of Molokai’ (1885); ‘A Troubled Heart’ (1885); ‘Hawaiian Life’; ‘Lazy Letters from Low Latitudes’ (1894); ‘The Wonder-workers of Padua’ (1896); ‘A Cruise under the Crescent’ (1898); ‘Over the Rocky Mountains to Alaska’ (1899); ‘Hither and Yon’; ‘In the Footprints of the Padres’ (1902); ‘Exits and Entrances’ (1903); ‘The Island of Tranquil Delights’ (1904). Consult James, G. W., ‘Charles Warren Stoddard’ (in ‘Apostrophe to a Skylark,’ Los Angeles 1909).

STODDARD, Elizabeth Drew Barstow, American poet and novelist: b. Mattapoisett, Mass., 6 May 1823; d. New York 1902. She was married to R. H. Stoddard (q.v.) and frequently collaborated with him in literary work. In addition to verse of not a little individuality she wrote three novels, ‘The Morgesons’ (1862); ‘Two Men’ (1865), and ‘Temple House’ (1867), which display vigor and originality. Her ‘Poems’ were collected in 1867.

STODDARD, Francis Hovey, American educator and writer: b. Middleburg, Vt., 25 April 1847, son of Solomon Stoddard, professor of languages in Middlebury College. He was graduated from Amherst College in 1869; studied for two years at Oxford, England; received the degree of M.A., from Amherst College in 1886, of Ph.D., from Western University of Pennsylvania in 1896 and of LL.D., from New York University in 1914. He was instructor in English at the University of California from 1886 to 1888 and professor of English language and literature at New York University from 1888 to 1914. From 1910 to 1914 he was dean of the College of Arts at New York University. He retired in 1914. He has published ‘The Modern Novel’ (1883); ‘The Ideal in Literature’ (1884); ‘Psycho-biography’ (1885); ‘Women in the English Universities’ (1886); ‘The Cædenon Poems’ (1887); ‘Conditions of Labor in England’ (1887); ‘Miracle Plays and Mysteries’ (1887); ‘Tolstoi and Matthew Arnold’ (1888); ‘The Uses of Rhetoric’ (1888); ‘Inductive Work in College Classes’ (1889); ‘Literary Spirit in the Colleges’ (1893); ‘Lord Byron’ (introduction to works, 1899); ‘The Evolution of the English Novel’ (1900); ‘The Life of Charles Butler’ (1903); ‘Poems of National Spirit’ (edited with introduction, 1904).

STODDARD, John Lawson, American lecturer and traveler: b. Brookline, Mass., 24 April 1850. He was graduated from Williams College, 1871 and studied divinity at Yale. He has traveled extensively and is the originator and promoter of the Stoddard Lectures in the larger cities of America. He has made his home in Italy for years. He has published ‘Red Letter Days Abroad’ (1884); ‘Glimpses of the World’ (1892); ‘Stoddard Lectures on Travels Abroad and in America’ (1898–1909); ‘The Stoddard Library’ (1910); ‘Poems’ (1911); ‘Poems on Lake Como’ (1914).

STODDARD, John Tappan, American educator: b. Northampton, Mass., 20 Oct. 1852. Prepared for college in the Northampton High School and after a year's experience in the wholesale woolen business in Boston entered Amherst College, graduated in 1874. Assistant principal of Northampton High School, 1874–75, graduate student in chemistry and physics at Amherst, 1875–76; University of Göttingen, 1876–77; received degree of A.M., and Ph.D., from Göttingen in November 1877. After two months in Paris he returned to Northampton and became a member of the faculty of Smith College, professor of physics and mathematics, 1878–81, of chemistry and physics, 1881–97, of chemistry, 1897. In 1886 he devised a practical method for making composite photographs (suggested by Francis Galton) and made many composites, especially of college classes, publishing two illustrated articles on composite photography in the *Century* magazine (March and November 1887). He invented the universally used wire-test tube holder (1889), a balance for first year's work and numerous other laboratory devices. Author of ‘Outline of Qualitative Analysis’ (1883), which has been widely used; ‘Lecture Notes on General Chemistry’ (1884–85, 2 vols.); ‘Quantitative Experiments in General Chemistry’ (1908); ‘Introduction to General Chemistry’ (1910); ‘The

Science of Billiards› (1913); ‹Introduction to Organic Chemistry› (1914); ‹Photography› in ‹Johnson's Universal Cyclopedia› (1905), besides many scientific articles and reviews.

STODDARD, Richard Henry, American poet and journalist: b. Hingham, Mass., 2 July 1825; d. New York 12 May 1903. He went to New York when very young and there he was employed for some time in an iron-foundry. He began, about 1848, to write in prose and verse for periodicals and ultimately devoted himself to literature. From 1853 to 1870 he was connected with the custom-house, in 1870–73 he was secretary to General McClellan, in 1860–70 was literary reviewer for the *World* and from 1880 for the *Mail and Express* (now the *Evening Mail*). The amount of his critical work in these posts was very large. He wrote much worthy verse, lyric and narrative, of a reflective cast patterned in the earlier period after Keats. ‹Abraham Lincoln,› an ode, is among his best efforts. Among his numerous writings are ‹Footprints› (1849); ‹Songs of Summer› (1856); ‹The King's Bell› (1862); ‹The Children of the Wood› (poems, 1867); ‹Putnam the Brave› (1869); ‹The Book of the East› (1871); ‹Memoir of E. A. Poe› (1875); ‹Poems› (1880, collected); ‹Life of Washington Irving› (1886); ‹The Lion's Cub› (1890), poems; and ‹Under the Evening Lamp› (1893), essays on Hogg, David Gray, Ebenezer Elliot, Edward Fitzgerald and others. His valuable collection of autographs and manuscripts was presented by him to the New York Authors' Club, a few months before his death. Consult his ‹Recollections, Personal and Literary,› edited by Ripley Hitchcock, with introduction by E. C. Stedman (1903).

STODDARD, William Osborne, American author and journalist: b. Homer, N. Y., 24 Sept. 1835. He was graduated at the University of Rochester in 1857, tried farming and journalism until 1861, when he was three months in the United States volunteers. He was secretary to President Lincoln, 1861–64 and United States marshal of Arkansas, 1864–66. Afterward he followed journalism and business pursuits in New York and took out nine patents for inventions. His publications are numerous and comprise verse, biography, fiction and adventure stories for boys. Among them are ‹Scanderoon› (1870); ‹Life of Abraham Lincoln› (1884); ‹The Talking Leaves› (1885); ‹The Red Mustang› (1890); ‹Table Talk of Lincoln› (1892); ‹The Lost Gold of the Montezumas› (1897); ‹The Errand Boy of Andrew Jackson› (1902); ‹The Boy Lincoln› (1905); ‹Dan Monroe› (1905); ‹Two Cadets with Washington› (1906); ‹In the Open› (1908); ‹Dab Kinzer› (1909); ‹The Captain of the Cat's-Paw› (1914).

STODDERT, stŏd'ẽrt, **Benjamin,** American Revolutionary soldier and statesman: b. Charles County, Md., 1751; d. Bladensburg, Md., 18 Dec. 1813. He was educated for mercantile pursuits, but on the outbreak of the Revolutionary War entered the Continental army and served with distinction until the battle of Brandywine, when he was severely wounded and obliged to retire from active service. At the time of his retirement he had the rank of major. He was Secretary of the Board of War till 1781. At the close of the war he established a mercantile business at Georgetown, D. C. In 1798 he was appointed Secretary of the Navy, holding the position till 1801. During his administration, war with France was threatened and he had charge of the organization of the naval force. For a time he served also as Secretary of War. At the close of his term he returned to business in Georgetown.

STOECKEL, Gustave Jacob, American musician and instructor: b. Maikammer, Germany, 9 Nov. 1819; d. Norfolk, Conn., 17 May 1907. He graduated from Kaiserslautern, Germany, and for several years was a teacher and organist. He came to the United States in 1847, becoming instructor in music at Yale University in 1849 and the organist in College Chapel. After 1890 he was professor emeritus of music. He published several collections of sacred music, several operas and College Hymn Book for male voices.

STOESSEL, Anatoli Mikhailovitch, Russian general: b. of Swedish parents in Saint Petersburg, 10 July 1848; d. 1915. He was educated in Paul Military School, Saint Petersburg, and entered the army in 1864, serving with distinction in the Russo-Turkish War, 1877–78. He was appointed colonel in 1889, major-general in 1899, commander of the Ninth East Siberian Sharpshooters' Brigade, 1900, and for meritorious services against the Boxers in the same year, was made a lieutenant-general. At the outbreak of the Japanese War in February 1904, he was appointed commander at Port Arthur, and soon afterward commander of the entire army corps ordered to the defense of that fortress, which he surrendered to the Japanese, 2 Jan. 1905. On 20 Feb. 1908 he was condemned to death (commuted to 10 years' imprisonment) «for surrendering the fortress before all means of defense had been exhausted; failing to enforce authority; and for military misdemeanors.» A year later he was pardoned.

STOEVER, Martin Luther, American educator and author: b. Germantown, Pa., 17 Feb. 1820; d. Gettysburg, Pa., 22 July 1870. He graduated from Pennsylvania College, Gettysburg, in 1838, and was a tutor there from 1839 to 1840, afterward becoming principal of the preparatory department and professor of Latin, history and political economy, a position which he very ably held until his death. For several years he acted as secretary of the General Synod of the Lutheran Church, and as editor of the *Evangelical Quarterly Review,* for which he wrote a series of ‹Reminiscences of Lutheran Ministers.› He also edited ‹The Literary Record› from 1847 to 1848. He published biographies of Dr. Henry M. Muhlenberg (1856), and of Dr. Philip F. Mayer (1859), and wrote ‹A Brief Sketch of the Lutheran Church in the United States› (1860). At the time of his death was preparing a full history on that subject.

STOHMANN, stō'man, **Frederick Karl Adolf,** German agricultural chemist: b. Bremen, 1832; d. 1897. He was educated at Göttingen University, Germany and London; was assistant professor under Graham at University College from 1853 to 1855, and afterward assistant at Celle. He organized the department for agricultural experiments at Brunswick in 1862;

in 1865 he accepted a call to Halle, and in 1871 became director of the agricultural physiological institute of Leipzig University. He wrote 'Beiträge zur Bedgründung einer rationellen Fütterung der Wiederkäuer' (1860); 'Biologische Studien' (1873); 'Handbuch der technischen Chemie' (1872); Handbuch der Zuckerfabrikation' (1878); 'Die Stärkefabrikation' (1878); 'Die Milch-und Molkereiproducte' (1898).

STOICISM, the Stoic system of philosophy and practical attitude toward life. The Stoic school of philosophy was founded at Athens, about 300 B.C. by Zeno, a native of Citium, in Cyprus. It received its name from the Stoa Pœcile, or mottled porch, where its meetings were held. Zeno had been a pupil of the Cynic Crates, and in its essential principle Stoicism may be regarded as the continuation and scientific development of Cynicism (q.v.). The successor of Zeno in the leadership of the school was Cleanthes, the author of the hymn to Zeus, who died 251 B.C. He was followed by Chrysippus who, on account of his great activity as a teacher and writer, is sometimes called the second founder of the school. The leadership, at Athens then passed the order to Zeno of Tarsus, Diogenes of Seleucia and Antipater of Tarsus. Of the numerous writings of these men and their contemporaries only a few fragments have come down to us.

Panætius of Rhodes (180–110 B.C.) and his contemporary, Boethius of Sidon, introduced new elements into Stoicism, bringing it into closer relations with the systems of Plato and Aristotle. It was mainly through the influence of the former that Stoicism was introduced into Rome. Panætius was the friend of Scipio Africanus and of Lælius, and the teacher in philosophy of many Roman youths of distinguished families. Cato, the younger, is perhaps the most famous Roman Stoic of the time of the republic. By the time of the empire, the original form of Stoicism had been greatly modified by the prevailing eclecticism of the age, and may almost be said to have ceased to exist as a scientific system. It still survived, however, as a popular moral philosophy, and in this form gave expression to many of the noblest ethical and religious convictions of the ancient world. Its chief representatives at this time whose works are still extant were Seneca, Epictetus and the Emperor Marcus Aurelius.

Stoicism, like all the later systems of Greek thought, was primarily practical in character. The end and object of philosophy for the stoic was to teach virture as the art of right living. But, in order to act rightly, it is necessary to be able to reason correctly and to understand the nature of the universe of which man is a part. Hence, logic and physics were regarded as indispensable preliminary studies for ethics, but not as possessing an independent value of their own. The extensive logical investigations undertaken by the Stoics contributed little of permanent value for the development of the science. In physics, their general view of the universe may be described as pantheistic materialism. Whatever exists is for the Stoics a material body. Not only do they maintain that all substances — including the soul and God — are corporeal, but they go on to describe as material all properties and relations of things, and even virtues and vices. Their view of the world was, however, essentially dynamic: all is process and movement. Moreover, the world-process forms a single whole, whose unitary principle is sometimes described in material terms, similar to those of Heraclitus (q.v.), as fire of warm breath, sometimes in spiritual terms as God, Providence, the Logos or Universal Reason, or Universal Law. In spite of the variety of terms, these names all have for the Stoics the same meaning, and describe at once both the essential substances of the world, and the ordering power and principle according to which it is regulated. There is no distinction to be made between God and the world, between matter and force. Further, these statements imply that every part of the world is ruled by the same unchanging laws, and is thus subjected to strict necessity. There is no chance or contingency anywhere; everything is ruled and governed by unvarying laws.

Man only differs from the other parts of the universe in that, as possessing consciousness and reason, he is able to learn the laws of nature and to follow them consciously and voluntarily. Hence we find that the fundamental doctrine of the Stoic ethics is contained in the injunction to "follow nature," to lead a "life according to nature." This general principle was made more specific, however, when it was pointed out (it is said by Chrysippus) that the laws of nature with which man is most directly and intimately concerned are those of human nature, and that he must therefore obey the fundamental laws which are found within himself. This implies that reason, the fundamental principle of human nature, shall govern action. Between the reason and the life of feeling and emotion there is the sharpest opposition. The highest good is not pleasure, or any object of desire, but virtue, the end which reason shows to be in harmony with our true nature. This sharp antithesis between virtue and pleasure was doubtless made more emphatic by the rivalry between the Stoic and the Epicurean schools. To regard pleasure as the good is, they maintain, to lose sight of the true nature of virtue, to base it upon the feelings and emotions, which are subject to external circumstances, and thus to deprive a man of his moral freedom and independence. The ideal of the wise man plays a very important part in the Stoic ethics. The wise man is completely free and independent, completely independent of external circumstances, and entirely emancipated from the bondage of the desires and emotions. For him virtue is the only good and vice the only evil: all external circumstances are indifferent; health, power, riches, even life itself are not real goods, nor is pain, poverty, contempt, or death evils. He has completely mastered his possessions through the insight of reason and the resulting strength of will, and has attained to a state of apathy, or freedom from the sway of the emotions. This ideal has been realized at best by very few men; the Stoics refer only to Socrates and Antisthenes, the founder of the Cynic school, as examples of its complete fulfilment. The wise man recognizes the necessity of all events, and welcomes whatever takes place as a part of the divine order of the universe.

The fundamental Stoic virtues are thus strength of will and resignation based on rational insight. These enable a man to bear cheerfully whatever lot fortune may apportion to him. Even when external circumstances make endurance no longer possible, but would compel a man to unworthy action, he may still triumph by voluntarily withdrawing from life by suicide. The Stoic gives up life, as he gives up external goods, as a means of preserving his own freedom and independence; and many of the most famous members of the school committed suicide in this spirit. In spite of the emphasis on the necessity of independence, the Stoics recognize that a life of reason implies social relations with one's fellow-men, and they give an important place in their system to the social duties and virtues, especially to the importance of justice, mercy and friendship. As reason is the essential basis of society, being the common element that unites a man with his fellows, they attach slight importance to citizenship in a particular country, and emphasize the cosmopolitan idea of social unity with all rational beings of every society and of every country. In this and in other doctrines, Stoicism, especially in its later form, goes beyond the conceptions usually prevailing in Greek ethics, and approaches the Christian idea of the universal brotherhood of man.

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STOJOWSKI, Sigismund, American pianist and composer: b. Strelzy, Poland, 1870. He studied under Zelenski in Cracow, and under Diémer, Paderewski, Dubois and Massenet in Paris. He toured Europe successfully as a pianist, and in 1906 became professor of pianoforte at the Institute of Musical Art, New York. Since 1913 he has been professor of pianoforte at the Von Lnde School of Music, New York. Author of 'Symphony in D Minor'; several violin sonatas and piano concertos; 'Romanza' for violin and orchestra; 'Der Frühling,' a choral work with orchestra; and many pieces for the piano and the violin.

STOKE NEWINGTON, a metropolitan borough of London, bounded east by Hackney and west by Islington. Area, 863 acres. Pop. 50,659.

STOKE-POGES, stōk pō'jĭs, England, a village of Buckinghamshire. It is the burial place of Thomas Gray, and its churchyard is the scene of the famous 'Elegy.'

STOKE-UPON-TRENT, England, a seaport and market-town, in Staffordshire, 14 miles northwest of Stafford, capital of the «Potteries» district. It dates mainly from the 18th century and has been greatly improved recently. The municipal buildings, free library, Minton Memorial, Hartshill infirmary, monuments to prominent citizens and public baths are noteworthy features. The industries and manufactures are varied, including earthenware, porcelain, tiles, tesselated floors or pavements, coal-mining, the manufacture of machinery, engines, etc. Pop. about 30,458.

STOKER, Bram (Abraham), English author: b. Dublin, 1848; d. 22 April 1912. He was educated at Dublin University. He entered the government civil service and while there he became noted as a literary, art and dramatic critic on various Dublin newspapers. In 1876 he was associated with Henry Irving in the management of the Lyceum Theatre and has published 'Under the Sunset' (1882); 'The Snakes' Pass' (1891) 'The Watter's Mou'' (1894); 'The Shoulder of Shasta' (1895); 'Dracula' (1897); 'Miss Betty' (1898); 'The Mystery of the Sea' (1902); 'The Jewel of Seven Stars' (1903); 'The Man' (1905); 'Personal Reminiscences of Henry Irving' (1906); 'Lady Athlyne' (1908); 'Snowbound' (1909); 'The Lady of the Shroud' (1910).

STOKER, SIR (William) Thornley, Irish surgeon: b. 6 March 1845; d. 3 June 1912. He obtained his early education in the Wymondham Grammar School, later studying in the College of Surgeons, Ireland, and Queen's College, Galway. He rapidly attained eminence in his practice and was created a knight in 1895 in recognition of his services to surgery. He was appointed surgeon to the City of Dublin Hospital in 1873; appointed surgeon to Richmond Hospital 1873, and Swift's Hospital 1876, later becoming governor. He was professor of anatomy in the Royal College of Surgeons, Ireland, 1876–89, and its president, 1894–96; governor of the Royal Hibernian Military School, the House of Industry Hospitals and of the National Gallery, Ireland; he was appointed inspector for Ireland under the Vivisection Act and was a Fellow of Royal University from 1890. He contributed many scientific papers on his profession to magazines and periodicals.

STOKES, Adrian, English painter: b. Southport, in 1854. He received his education at the Liverpool Institute and the Royal Academy Schools, London. He has exhibited works at the Royal Academy each year since 1876 and has been awarded medals at the Paris Exhibition, 1889, and the World's Fair at Chicago, 1893. He has also written much on art for magazines and newspapers.

STOKES, Anson Phelps, American financier and reformer, father of J. G. P. Stokes and A. P. Stokes (qq.v.): b. New York, 22 Feb. 1838; d. 28 June 1913. He was early engaged in the mercantile business, later was a member of the banking firm, Phelps, Stokes and Company, and was prominent in financial circles. He was the first president of the Reform Club, New York; was vice-president of the Civil Service Reform Association, and was president of the National Association of Anti-Imperialist clubs. He was deeply interested in social reforms and was prominent in works of charity, to which he contributed liberally. Author of Joint-Metallism' (1894; 5th ed., 1896); 'Cruising in the West Indies' (1902); 'Cruising in the Caribbean with a Camera' (1903).

STOKES, Anson Phelps, American Protestant Episcopal clergyman and educational writer, son of A. P. Stokes (q.v.): b. New Brighton, S. I., 13 April 1874. He was graduated at Yale University in 1896 and at the Episcopal Theological Seminary, Cambridge, in 1900. He traveled in China, Japan, India and other countries in 1896–97; has been secretary of Yale University since 1899, and minister of Saint Paul's Church, New Haven, since 1900. He is also secretary of the Phelps Stokes Foundation for educational work among negroes; and since 1912 has been a member of the General Education Board. Author of ‹Memorials of Eminent Yale Men› (1914); ‹What Jesus Christ Thought of Himself› (1916); ‹Historic Universities in a Democracy› (1913); ‹The Question of Preparedness› (1916).

STOKES, Frank Wilbert, American artist; b. Nashville, Tenn. He was educated at Philadelphia, Pa.; studied music under Prof. Hugh Clark of the University of Pennsylvania, and art under Eakins, at Philadelphia Academy of Fine Arts. In Paris he studied art under Gérôme at École des Beaux Arts; also at Colorni's under Raphael Collin and Academy Julien under Boulanger and Lefevre. He lived four years at Etampes, Pas-du-Calais; exhibited at Salon Société-des-Artistes Français for four years; returned to United States in 1891; in 1892 accompanied Peary Relief Expedition for *Scribners Magazine;* in 1893 was artist member of Peary's North Greenland Expedition, 17 months in Bowdoin Bay, Greenland, building a studio and painting from natives and nature. Remained in Philadelphia until 1900 then going to New York City in 1901 joined the Swedish Antarctic Expedition under Dr. Otto Nordenskjold, at Buenos Aires, Argentine, remained about eight and one-half months painting from nature as member of the «Land Party.» The expedition failed in landing on the Antarctic continent and Mr. Stokes left the expedition at Port Stanley, Falkland Islands, and thence by steamer to Montevedio, Uruguay, Buenos Aires and finally via Antwerp returned to the United States. Mr. Stokes paid his way with all of the above expeditions, in order to be independent and do his special work. Lectured and exhibited at various places in the United States and Canada, London, England, and exhibited paintings at Salon of Société Nationale des Beaux Arts; lectured before Société de Geographie de Paris, also before Societa Geografica Italiana, Rome, Italy, before the king and queen. Awarded Prix Alphonse de Montyot silver medal by the Société de Geographie de Paris. Painted and completed in 1909 a series of mural decorations for Eskimo Hall of the American Museum of Natural History of New York, on legends and the life of the Eskimo. His publications include essays in ‹Color in Far North› (1894); ‹An Arctic Studio› (1896); ‹Essentials of Polar Expedition› (1900), in Philadelphia *Saturday Evening Post;* ‹Aurora Borealis›; ‹An Art in the Antarctic› and ‹In the Tropics› (in *Century Magazine* 1903); ‹Color in Polar Worlds› (1906), International Geographical Congress.

STOKES, Frederick Abbott, American publisher: b. Brooklyn, N. Y., 4 Nov. 1857. He was graduated at Yale University in 1879 and in 1881 established a publishing house known as White and Stokes. The firm became White, Stokes and Allen in 1883; Frederick A. Stokes in 1887; Frederick A. Stokes and Brother in 1888; and since 1890 has been Frederick A. Stokes Company, Mr. Stokes being its president. He edited ‹Poems of Sir John Suckling› (1886); and the *Pocket Magazine* in 1898–1901; and has contributed to various magazines.

STOKES, Sir George Gabriel, British mathematician and physicist: b. Skreen, County Sligo, Ireland, 13 Aug. 1819; d. 1903. He was graduated at Cambridge in 1841, in the same year was elected a Fellow of Pembroke College and was elected Lucasian professor of mathematics at Cambridge in 1849. In 1885 he became president of the Royal Society and from 1887 to 1892 was member of Parliament for Cambridge University. He was made a baronet in 1889 and in 1902 became master of Pembroke College. He was distinguished as an expounder of the principles of hydrodynamics and of the phenomena of fluorescence and phosphorescence and he was the first to demonstrate in college and public lectures the scientific principles of spectrum analysis. He greatly extended the field of physical inquiry and demonstrated more clearly than had ever before been done the relation of physics and the natural sciences in general to higher mathematics. He was also a high authority on optics. His work, especially in mathematical physics, was brilliant and exact. He attempted successfully the solution of problems thought by leading scientists to be practically unsolvable. His publications include the ‹Burnet Lectures on Light› (1892); ‹Mathematical and Physical Papers› (1880–1902); ‹Gifford Lectures on Natural Theology› (1891–93), and more than 100 important papers printed in the transactions of learned societies. His mathematical and physical papers were collected and published in five volumes at Cambridge (1880, 1883, 1901, 1904 and 1905), and his ‹Memoir and Scientific Correspondence,› also at Cambridge in 1907. Consult Brown, E. W., ‹Biography of Stokes› (in ‹Annual Report of Smithsonian Institution, 1904,› Washington 1905).

STOKES, Henry Newlin, American chemist: b. Moorestown, N. J., 24 Oct. 1859. He was graduated at Haverford College (1878) and received the degree of Ph.D., at Johns Hopkins (1884), whence he went to Europe. From 1884–89 he studied at the University of Munich and Federal Polytechnic, Zurich, Switzerland. He was chemist for the United States Geological Survey 1889–92 and 1894–1903, becoming assistant professor of inorganic chemistry (1892–93) and associate chemist, Bureau of Standards (1903–09).

STOKES, James Graham Phelps, American Socialist: b. New York, 18 March 1872. He was son of Anson Phelps Stokes and was graduated (1892) at Sheffield Scientific School (Yale). In 1896 he received the degree M.D., at the College of Physicians and Surgeons (Columbia), when he took up graduate work in the School of Political Science, Columbia (1896–97). In 1905 he married Rose Harriet Pastor, prominent Socialist leader and lecturer. He spent much time on the governing boards of the corporations in which his family estate was interested. In very numerous philanthropic institutions, such as the New York Association for Improving the Condition of the Poor, University Settlement Society, Federation of Christian Churches and Christian Workers, Peoples' Institute, Tuskegee Normal and Industrial Institute, etc., he has done much practical work. From 1906 he has devoted his activities largely to the Socialist cause, being president of the Intercollegiate Socialist Society (1907–17), presidential elector on Populist ticket (1904), vice-chairman, Municipal Ownership League, its candidate for president of board of aldermen, New York (1905). In 1911 he was member of the State executive committee of the Socialist party of Connecticut; candidate for New York assembly (1908); candidate for mayor of Stamford, Conn. (1912). In 1917 he withdrew from the Socialist party, together with numerous other leaders when the party views were pacifist and antagonistic to the American government and its war policy. In the latter year he became vice-chairman of the Nationalist party, secretary-treasurer of the Social Democratic League of America, etc. He enlisted (1917) in the Veteran Corps of Artillery, New York, and was transferred to Ninth Coast Artillery, New York.

STOKES, Whitley, Irish Celtic scholar: b. Dublin, 28 Feb. 1830; d. 1909. He was educated at Trinity College, Dublin, and called to the bar at the Inner Temple in 1855. He went to India in 1862 and became successively secretary to the governor-general's legislative council and to the legislative department of the government of India. In 1877–82 he was law member of the governor-general's council and during his official career in India drafted the greater part of the present Anglo-Indian codes of civil and criminal procedure (4 vols., 1887–91) and numerous acts relating to property, trusts, etc. In 1879 he was president of the Indian Law Commission. In 1868 he proposed a scheme for collecting and cataloging the Sanskrit manuscript preserved in India. His published works include those treating of legal and those dealing with Celtic subjects, by the latter of which he is best known to the literary and scientific world. He began his Celtic studies in his youth and continued them enthusiastically all his life. Most of his work is of a very learned nature, and some of it is of high literary merit. Especially faithful and sympathetic are his translations from Celtic into English. His Celtic studies and writings include Irish, Scotch, Welsh, Breton and Cornish. He has placed, through his researches, a vast amount of early Celtic material at the disposition of students of the Celtic tongues. The former comprise 'Treatise on the Liens of Legal Practitioners' (1860); 'On Powers of Attorney' (1861); 'Hindu Law Books' (1865); 'The Older Statutes in Force in India, with Notes' (1874); and 'The Anglo-Indian Codes' (1887–8; supplements, 1889–91) etc. Among his Celtic works may be named 'Irish Glosses' (1860); 'Three Irish Glossaries' (1862); 'The Play of the Sacrament' (1862); 'The Passion, a Middle Cornish Poem' (1862); 'The Creation of the World, a Cornish Mystery' (1863); 'Three Middle Irish Families' (1871); 'Goidelica' (1872); 'The Life of Saint Meriasek' (1872); 'Middle-Breton Hours' (1876); 'The Calendar of Aengus' (1880); 'Tripartite Life of Saint Patrick' (1887, in the Rolls Series); 'Lives of Saints from the Book of Lismore' (1889); 'Urkeltischer Sprachschatz' (1894), with Bezzenberger; 'The Martyrology of O. Gorman' (1895); 'The Annals of Tigernach' (1897); 'The Eulogy of Saint Columba' (1899). He is joint-editor of 'Irische Texte' and of the 'Archiv für Celtische Lexikographie.'

STOKOWSKY, stō-kŏf'skĭ, **Leopold,** American orchestral conductor: b. London, Eng., 1882. He was graduated at Queen's College, Oxford, studied instrumentation at Paris and came to New York in 1905. He conducted symphony, operatic and oratorio work in Paris, and was musical director (1905–08) of the New York Saint Bartholomew's choir. From 1909–12 he was conductor of the Cincinnati Orchestra, and (since 1912) of the Philadelphia Orchestra.

STOLA, the Latin name of a loose garment worn by Roman matrons over the tunic. To the bottom of it a border or flounce was sewed, the whole reaching down so low as to conceal the ankles and part of the feet. It was the characteristic dress of the Roman matrons, as the toga was of the men. Divorced women or courtesans were not allowed to wear it. It was usually gathered and confined at the waist by a girdle, and frequently ornamented at the throat by a colored border. It had either short or long sleeves and was fastened over the shoulder by a fibula.

STOLBERG, stŏl'bĕrk, **Christian,** Count, German author: b. Hamburg, 1748; d. 1821. He traveled through Switzerland and North Italy in company with Goethe and Lavater, and finally settled in Schleswig where he wrote poems and dramas. He made excellent translations into German of the Greek poet Sophocles, and other works from the Greek. His poems, which are generally of an intimate nature and depict faithfully and sympathetically family life, were published in several editions under the simple title of 'Gedichte' (1779, 1782, 1787, 1810). He was a brother of Friedrich Stolberg, and the works of the two brothers were published in 20 volumes under the general title 'Werke der Brüder Stolberg' (Hamburg (1820–25). Stolberg was influenced by Klopstock.

STOLBERG, Friedrich Leopold, Count, German poet, brother of Christian Stolberg (q.v.): b. Bramsted, 1750; d. 1819. He wrote plays, poems, travels and translated the 'Iliad,' four tragedies of Æschylus, some of the works of Plato and Ossian's poems. From 1777 to 1780 he was Ambassador to Copenhagen for Prince-Bishop of Lubeck; and Ambassador for Denmark at Berlin (1780–89). He also held other important official positions. In 1800 he and his whole family became converts to Catholicism. From this time on he lived in comparative retirement, devoting his energies to literary work. He wrote an elaborate 'History of the Religion of Jesus Christ' (15 vols., 1807–18). Consult Hennes, J. H. (Frankfort 1876); Janssen, J. (Friedburg 1900), and Menge, T. (Gotha 1862) for biographical studies.

STOLE (Latin *stola*, long robe), a long narrow band or scarf with fringed ends, worn by ecclesiastics of the Roman Catholic and Protestant Episcopal churches, by deacons over the left shoulder, being fastened under the right arm; by bishops round the neck with both ends pendant in front to the knees; and by priests similarly, but with the ends crossed over the breast at mass.

STOLP, stŏlp, or **STOLPE**, stŏl'p, a town in Prussia, in the province of Pomerania, on the river of its own name, 64 miles west of Dantzig. The interesting features are a castle of the 16th century, two good churches, the ancient town-gates and several schools. The industries are chiefly fishing, iron founding, linen weaving and amber turning. There is some trade in cattle, fish, geese, grain and liquor. The port is Stolpmünde at the mouth of the river. This is also a favorite summer resort. It formerly belonged to the Hanseatic League, from which it passed to Brandenburg in 1637. Pop. about 35,000.

STOLYPIN, stŏl'y-pēn, **Peter Arkadievitch**, Russian statesman: b. 1862; d. 1911. He studied at Saint Petersburg University, and (1885) was engaged in the 'department of public domains. He became president of the provincial court in the government of Kovno, and was promoted (1902) to governor of Grodno, and (1903) governor of Saratov. He was appointed Minister of the Interior in 1906, and then constitutional Premier after Goremykin's Duma was dissolved. He placed most of the empire under martial law to suppress the growing elements of revolution, and he was assassinated in 1911.

STOMACH. The ancients conceived digestion (q.v.) as a process of cooking, executed by the animal heat of the body. Not until the 17th century was the idea advanced that digestion in the stomach was a chemical process largely due to ferments. In 1752 Réaumur, and in 1783 Spallanzani, established that the main factor in digestion was a secretion of the stomach, the gastric juice, which dissolved and transformed the ingested foodstuffs chemically. Previous to that time — even in the 17th century — digestion was thought to be due to a mechanical trituration of the food, Réaumur knew that the secretion of the stomach was acid, but it was not until 1834 that Prout discovered that the acidity was due to hydrochloric acid (HCl). In 1836 Schwann recognized the active ferment of the gastric juice, the pepsin.

A research work of the most far-reaching importance concerning the nature of stomach digestion was executed by the American military surgeon, William Beaumont, on the stomach of the Canadian hunter, Alexis St. Martin. After a gunshort wound had opened the organ, it healed not perfectly but, leaving a fistula permitting introspection and direct, objective study of digestion. The investigations of Beaumont constitute what may justly be designated as the most epoch-making research on the physiology of the human stomach. ('Experiments and Observations on the Gastric Juice and the Physiology of Digestion,' Plattsburg, N. Y., 1833).

The digestive processes in the intestines were first systematically studied by Claud Bernard, who discovered in 1848 that the pancreatic juice digested fats. Corvoisart in 1857 discovered the albumen-digesting power of the pancreatic juice. In 1865 the secretion of the intestinal glands was gained in a pure state by Thiry. Valuable contributions to the physiology of digestion in the stomach and intestines have been made by J. P. Pawlow, of the Institute for Experimental Medicine, Saint Petersburg. These scholarly researches belong to the most recent acquisitions of our knowledge of the digestive tract. Still much remains to be worked out. Even at the present time the function of the bile is not completely understood, nor are the functions of the liver and pancreas satisfactorily investigated. In a brief and practical account like this, the reader seeks only well-ascertained facts and not hypotheses. What he wants to know is (1) how the stomach works under healthy conditions, what are its normal performances, and (2) how its abnormal conditions are brought about, how its diseases are manifested, and what are the best means of avoiding or curing them.

Normal Gastric Digestion.— For an understanding of the normal functions of the stomach, a brief reference to recent discoveries is indispensable. The stomach is not the main digestive organ, only one-seventh of the entire digestive process occurs in it. The remaining six-sevenths of digestion are carried on in the intestines. But it would be a grave error to assume for this reason that the stomach is not necessary for the digestive process. For so dependent is intestinal digestion upon gastric digestion that it is impossible to have a normal digestion in the intestines without a previous digestion in the stomach. It is also a mistake to assume that the intestinal digestion is normal in individuals who for surgical reasons have had to undergo the operation of the removal of the stomach as a whole or in part. None of such operated cases where the entire stomach was removed have lived over a year or six months, although they were kept under constant supervision and the most careful dietetic control.

The chemical changes which the various food-articles undergo in the stomach are of far-reaching importance for the changes which are to occur in these foods after they reach the intestines. Many of the old authors, beginning with the American physiologist, Beaumont, believe that the mechanical irritation of the foods causes the gastric secretion, but the experiments in Pawlow's laboratory have proved the fallacy of this view. In the first place, if the secretions were due to simple mechanical irritation, there is no reason why irritation with the point of a glass rod, with a feather, or with sand placed in the stomach, should not also cause the secretion. A secretion may be caused by mechanic irritation, but it is composed mainly of a liquid resembling plasma, containing mucus, and having no digestive power. The mistake of the older experimenters, according to Pawlow, grew out of the fact that they ignored the so-called *psychic secretion*, a secretion which can be set up by the mere smell or sight of food, or even by a very intense feeling of hunger. If the œsophagus of a dog be cut in the neck and its end sewed to the edges of the wound, and at the same time a gastric fistula be established, pieces of meat which are fed to the dog after healing of these fistulæ will not reach the stomach, but will fall out of the upper end of the fistula leading into the œsophagus. Nevertheless in five to six minutes after the swallowing of the food gastric juice begins to be secreted, running from the gastric canula first in drops and afterward in a continuous stream. If the dog be offered meat without receiving it, the gastric secretion will also appear, though not so plentifully as when the dog was actually allowed to chew the meat. A further interesting fact observed in dogs so experimented on was that no secretion followed the swallowing of indigestible substances like small stones. These experiments furthermore suggested that for every kind of food a definite gastric secretion is formed of specific composition. Therefore it has been said that the stomach provides a special gastric juice to meet each dietetic requirement. It must therefore be further studied whether the mucous membrane of the stomach is capable of distinguishing between the varieties and classes of foods that come in contact with it, much as the skin recognizes mechanical, chemical, thermic and electrical stimulation.

It might be asked, «What is the object of this psychic secretion?» for Pawlow has clearly established the existence of two kinds of gastric secretion, the chemic and the psychic. This question applied to the human physiology would be the same as inquiring, «What is the object of the appetite?» The answer is, that under the influence of the psychic secretion a gastric juice is furnished which is much more effective than that which is secreted under purely chemical stimulation of the food, that is, when food is taken without any special appetite. Furthermore, under the influence of psychic secretion foods which would otherwise not stimulate the gastric mucosa to secretion become converted by the already present psychic secretion into something else which constitutes a further stimulant to the secretion of gastric juice. For instance, if a solution of albumen be administered to a dog upon which a Pawlow operation has been performed, that is, splitting off part of the stomach, with all the vessels and nerves intact, and making this second smaller stomach communicate with the abdominal wall, but not with the general cavity of the large stomach from which it is dissected (see Hemmeter's Practical Physiology) there will be no secretion from the small stomach, for albumen by itself does not excite chemical secretion. But if the psychic secretion is previously set up by some other means, before the albumen is placed in the large stomach — for instance, by waving a piece of meat before the dog's eyes — then, following the introduction of albumen, a secretion will be found in the small (artificial) stomach which is qualitatively and quantitatively greater than the psychic secretion alone, or when albumen is given alone, it is evident that, while albumen in itself does not excite secretion, the products of albumen do cause this secretion. The same is true of pieces of bread which, when placed in the large stomach through the fistula, will not promote a secretion; but if the dog is allowed to swallow the bread, secretion begins and continues for several hours. Psychic secretion therefore is a preparatory secretion, transforming substances, which otherwise would not stimulate the stomach into such forms as can accomplish this stimulation. The fact that bread will cause a secretion when chewed and swallowed and not when placed directly in the stomach through the fistula, may be interpreted (as by Pawlow and Peter Borisoff) as proving the secretion of a gastric juice under psychic influence; but — as will be shown presently — it may be due to a special body formed in the salivary glands and reaching the blood eventually circulates through the glands of the stomach and stimulates gastric secretion.

Edkin has demonstrated that the pyloric mucosa forms a chemic substance during digestion which also stimulates gastric secretion after it has once been started by other mechanisms. Further revelations from Pawlow's laboratory disclose very important relations between the various classes of food, permitting the conclusion that they may mutually advance or interfere with the digestion of their various constitutents in the gastric chyme. For instance, starch paste does not by itself promote gastric secretion, but when mixed with meat it was found to accelerate the action of the gastric juice, increasing its digestive power. Furthermore, it was demonstrated that the stomach is capable of distinguishing between lactic, butyric and hydrochloric acids and responded to each of these acids with a varying quantitative secretion. As lactic and butyric acids are either contained in the food as such or are products of gastric fermentation, their stimulating influence on gastric secretion is of therapeutic importance. It is evident, therefore, not only that the stomach is extremely delicate in detecting the composition of foods and regulating the composition of its secretion correspondingly, but that it can distinguish between various organic acids. These experiments furthermore gave the clue to the treatment of gastric secretory disorders not by drugs merely but by dietetic measures.

Hemmeter found that extracts made from salivary glands that were removed from animals during the act of chewing, when injected into the general circulation of dogs caused a flow of gastric juice. This occurred when the animal's stomach was empty. All of these chemic agents that correlate the function of physiologically and anatomically distant organs are called *Hormones* by Starling (from the Greek ὡρμαω (I stimulate).

The human stomach accomplishes its work by the means of three essential functions, secretion, absorption and peristalsis (this term refers to the movements of the stomach). The secretion of the gastric glands owes its digestive power to hydrochloric acid and three ferments. The quantity of hydrochloric acid amounts to two parts in the 1,000 of gastric juice. The ferments are pepsin, which acts mainly on the proteid constituents of food like meat and egg, rennin or chymosin, which acts principally upon milk, precipitating the casein; lipase, which is a fat-digesting ferment; and the new gastric ferment, «chymaze,» which is not a digestant of food, but an accelerator of the digesting action of the ferments of the pancreatic juice. (International Clinics, Vol. II, 12th Series, p. 276, article by Peter Borisof).

Dependence of Intestinal upon Gastric Digestion.— It is a prevalent opinion among the laity that the stomach has a marked absorptive power. This is a natural consequence of an older error, according to which the stomach is the chief digestive organ, it having been formerly believed that by far the greater part of the digestive act takes place in the stomach.

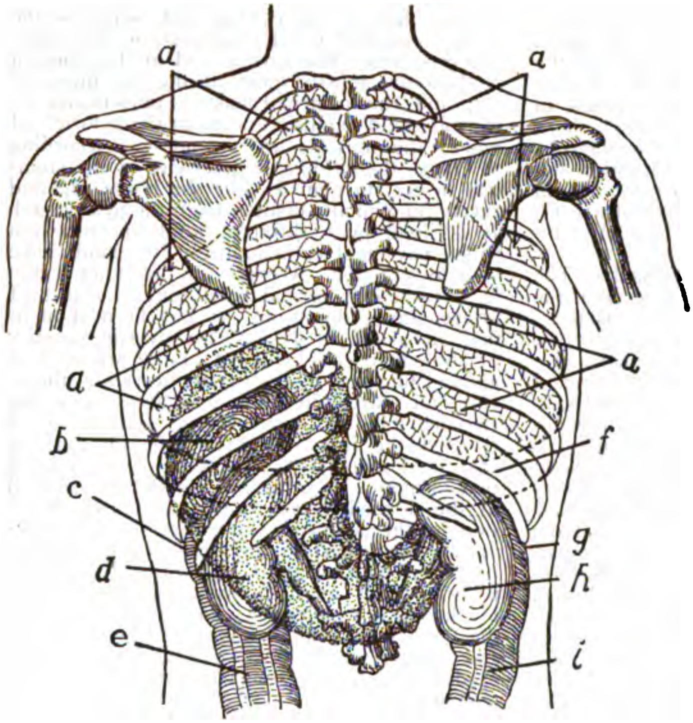
As already intimated, the actual digestion which takes place in the stomach is insignificant compared with that which takes place in the intestine. Later it will be shown here that the secretion of pancreatic juice depends upon the liberation from the membrane of duodenum, or first part of the bowel, of an agent called ***duodenal secretin,*** another hormone (discovered by Bayliss and Starling), and that the liberation and secretion of this agent depends upon the presence of hydrochloric acid in the gastric chyme. So that if this acid is not present in the chyme as it enters the upper bowel, there can be no normal performance of intestinal digestion. Just as normal gastric digestion depends upon a normal condition of the mouth and normal salivary secretion, so normal intestinal digestion depends upon a normal stomach.

Absorption from the Stomach.— The amount of absorption that takes place from the stomach is surprisingly small. Water is practically not absorbed at all, for it appears that fully 95 to 100 per cent of all water taken into the stomach is passed out into the duodenum and absorbed from the intestine. Alcohol and substances in solution of alcohol are readily absorbed. Grape-sugar, milk, cane-sugar and maltose are absorbed in moderate amounts when they are in aqueous solution. When they are in alcoholic solution larger amounts are absorbed. Dextrin and peptones are also taken up from the stomach, but in smaller amounts than sugar. The amount of these substances absorbed increases with the concentration of the solution. But simultaneously with this absorption occurs a more or less active secretion of water into the stomach, which secretion increases or diminishes directly in proportion to the amounts of the substances absorbed. So that under certain conditions it is possible to draw more water out of the stomach by means of a stomach-tube than has been drunk half an hour previously, which certainly refutes the assumption that water could be absorbed from the stomach, and favors the view that water is not only not absorbed, but that it is actually secreted into the stomach under certain conditions. This conclusion is of great value in the treatment of certain dyspepsias characterized by a weakened condition of the gastric musculature; for in these the contractile power of the stomach is not sufficient to expel the water into the bowel in the proper time. And as water is, bulk for bulk, the heaviest substance which the human being takes into the stomach, its retention in the stomach beyond a certain length of time drags down and exhausts the already attenuated gastric muscularis and dilutes the already weakened gastric secretion. Therefore in some forms of gastric atony an essential part of the treatment consists in restricting the amount of water to the lowest possible requisite or to give it by means of colon-injections, if necessary, for a time at least; or if some of it must be taken by way of mouth, to induce the patient to lie on his right side and by means of massage to facilitate the expulsion of the water from the stomach into the intestine.

The Gastric Peristalsis or Motor Function of the Stomach.— This is perhaps the most important function of the stomach, for not only does the motor function mix and churn up the gastric contents, but it expels them at the proper time into the bowels. An animal might live without a gastric secretion, or with a stomach which could not absorb anything, but it could not live with a stomach that had no peristalsis. The muscular layer of the stomach is much thicker and stronger at the pyloric end, which is near the outlet toward the intestine, than at the cardiac end, which is the dilated rounded pouch extending in the opposite direction. The cardiac end of the stomach is therefore mostly quiet during the digestive act, and the principal gastric movements of churning and expulsion occur in the pyloric end where the muscles are strongest. According to Oppel, the cardiac or quiet end of the stomach in certain animals, like the horse, pig and rat, is functionally distinct from the pyloric end. It is lined by a different kind of epthelium called pavement epthelium and its glands have no acid secretion. Accordingly this quiet region is, even under normal conditions, the seat of active starch digestion. It has been thought that, inasmuch as the starch-converting agency of the saliva could not act in the presence of an acid like that of the gastric secretion, therefore, all starch digestion was arrested in the stomach and was not resumed until the food reached the intestine. That this is not the case is shown by W. B. Cannon, who proved that in man as in other animals the cardiac end of the stomach serves chiefly for starch digestion by the action of the salivary ptyalin during the early part of digestion in the stomach. ('American Journal of Physiology,' Vol. VI, p. 396). This again emphasizes the importance of thorough mastication, for only thereby can the food be thoroughly penetrated by the saliva and further starch conversion take place in the cardiac end of the stomach during gastric digestion.

The movements which food undergoes in the stomach during digestion can be studied by the aid of the X-rays. An inert and insoluble substance which is capable of cutting off the X-rays must be mixed with the food in order to make the gastric movements visible before the Roentgen apparatus. Bismuth subnitrate answers this purpose admirably. Even the movements of the human stomach can be studied by adding this insoluble substance to the food and placing the individual who has eaten it before the X-ray instrument. In this way it has been discovered that the pyloric or highly muscular portion of the stomach is the part where the most effective gastric movements are brought about. The movements in the other portions of the stomach are not of sufficient force to be noticeable before the X-ray apparatus. It seems probable, therefore, that the fundus or pouch end of the stomach serves simply to push the food into the pyloric end, where it is churned to and fro for a while and eventually expelled into the duodenum. Three or four inches from the exit of the stomach, known as the pylorus, the musculature of the stomach is particularly strongly developed (sphincter muscle of the antrum pylori); and here it is that the stomach may constrict to such an extent as to partition off a special portion of the pyloric end and expel the food into the duodenum without permitting of any regurgitation into the fundic end. All this is in contradiction of the view originally held by Beaumont and still quoted in some of the textbooks of physiology, namely, that there is a regular circuit of food around the walls of the gastric cavity.

Structure of the Stomach.— It is impossible to enter here into a consideration of the microscopic structure of the stomach, although this is indispensable for the proper understanding of its abnormal functioning. Much is yet to be learned concerning the cells of the peptic glands and their function. It is certain, however, that the different products of the gastric secretion, the hydrochloric acid and the ferments, do not originate in the same cells, but that there are acid-producing cells and ferment-producing cells in the glands within the stomach. It is even conceivable that the different ferments of the stomach are produced by different cells. The organ is composed of five different coats. Passing from without inward, these are (1) the peritoneal; (2) the muscular coat, which is in turn composed of the longitudinal and circular layers; (3) a connective tissue layer; (4) a very small thin layer of muscular tissue, called the muscularis mucosæ, separating the connective tissue from the glandular layer; (5) the glandular layer itself, innermost of all. In addition to these structures the stomach is permeated by arteries and veins, a liberal network of lymphatics and is richly supplied with nerves. The glandular layer is bordered by a stratum of columna epithelial cells.



DORSAL VIEW.
(Dotted area shows location of Stomach).

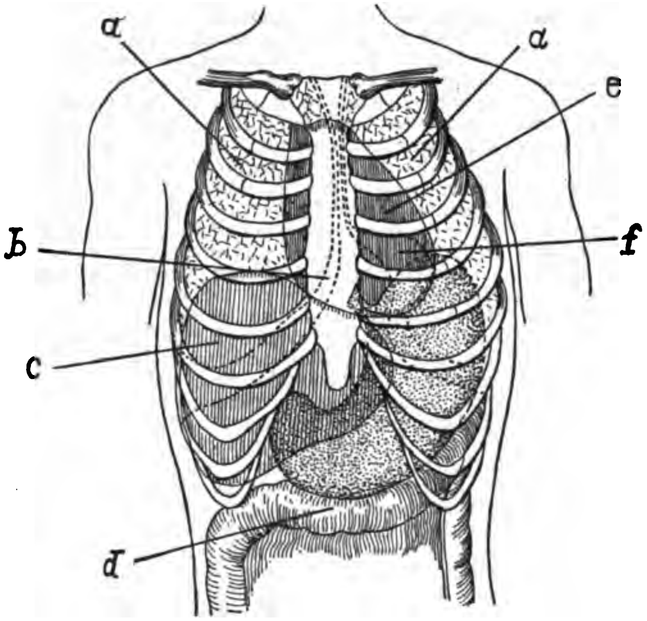
a. Lungs.
b. Spleen.
c. Splenic flexure.
d. Left kidney.
e. Descending colon.
f. Complementary space.
g. Hepatic flexure.
h. Right kidney.
i. Ascending colon.

The Abnormal Digestion of the Stomach; Gastric Diseases.— One of the first and most important things to decide when an individual complains of dyspepsia, or of any distress, pain, distention or symptom referable to the stomach, is whether the signs and symptoms are really traceable to the stomach or not. For one may have all the symptoms of gastric disease and yet the stomach itself may not be abnormal either in structure or function. For instance, the stomach may give rise to abnormal sensations as a consequence of disease of other organs. The organs which most frequently derange the stomach in this manner are the heart, liver and kidneys. Even physicians of experience who have become afflicted with abnormal gastric digestion have been at times deceived concerning the true source of their malady. Fully two-thirds of all gastric sufferers who come to special clinics devoted to diseases of the stomach are suffering not from any primary disease of the stomach whatever, but either from a nervous affection of the stomach or from one of the gastric derangements that are secondary to disease of other organs. Perhaps the most frequent of these disorders are those that are due to the nervous gastric affection, or as they are called, the *gastric neuroses.* To determine precisely the exact nature of an affection of the stomach, the chemical analysis and microscopic examination of known test-meals is indispensable. According to the gravity of the morbid condition, a heavy or a light test-meal is given and a certain time after it is eaten the stomach tube is passed into the stomach and a certain amount of the gastric contents withdrawn for analysis. As long as this is not done, all deductions from the symptoms and signs alone are conjectural. That is not to say that the inferences drawn from test-meal analysis and microscopical examination of test-meals are always conclusive. It is frequently necessary to examine also the blood and the urine of the patient and even to examine the stools after certain test-meals. Recently the method of fractional analysis of test-meal samples drawn at short intervals has been rediscovered. In a way it is of interest to ascertain the time relations of the gastric secretion, that is, when it reaches its height. Clinically, however, the expediency, feasibility and possibility of this method are still “*subjudice.*” Then all the other organs of the body should be carefully examined, bearing in mind that it is not always correct to presume that a patient has a disease of his stomach because he has gastric symptoms. The reverse is equally true, that a patient may have no symptoms whatever referring to the stomach and yet have very grave disease of this organ. The gravest affection which may befall the organ — cancer of the stomach — has been known to run its entire course and cause death in a latent manner; that is, without giving a single symptom referrable to the stomach. This is an instance where a patient may have a gastric disease and no gastric symptom. A person who suffered from almost complete blindness, yet manifested no disease in his eyes, was found after exhaustive study to have been thus affected by a poison circulating in his blood, which was absorbed from his gastro-intestinal canal and was due to an abnormal digestion. Under treatment directed toward his stomach and intestine his vision gradually returned.

It is important to avoid aggravating an existing trouble by illogical and promiscuous medication, faulty diet and the use of alcoholic stimulants. Between 80 and 90 per cent of the so-called stomach tonics, liver regulators and stomach bitters are composed of alcohol. But even the prescriptions of physicians are not always adapted to the existing conditions. One of the most frequent abuses among practitioners of medicine is the indiscriminate dosing with mixtures containing pepsin. In a similar manner the ferments which convert the starches, the carbohydrates, into sugar, have been much abused. These substances are called *diastases*. Now diastase is a ferment with which the digestive tract is abundantly supplied. It exists in the saliva in the shape of a ferment called *ptyalin*, and in many hundreds of tests with human saliva it has been discovered in only 2 per cent of the cases that this substance was not secreted in sufficient quantity. It is conceivable, however, that in a mouth which has been made offensive by carious teeth, by a badly coated tongue, enlarged tonsils and catarrh of the mouth, throat and nose, this ptyalin can be destroyed and rendered ineffective; it can also be inhibited by the loss of alkilinity of the saliva in acidosis and gout. The proper thing to do then is not to give ptyalin or diastase in form of a medicine, but to cure the abnormal condition of the mouth and general system. A frequent form of gastric disturbance is called by general practitioners "amylaceous dyspepsia," which is an objectionable name given to the symptoms of hyperacidity and hypersecretion. This disease is frequently treated by cutting off the carbohydrates or starchy foods, which is irrational, because they cannot be dispensed with, not on account of the starch only, but on account of the proteid which amylaceous foods contain. It will be found from the army rations of men under service of various nations that the carbohydrate portion of the foods is increased with harder work much more than the proteid or fat portion. Therefore these foods should not be taken away because they may not be perfectly digested; but the cause of the indigestion should, if possible, be removed. If possible, a large amount of natural saliva should be swallowed after meals. Often it has been observed that with the simple supply of additional saliva caused by chewing a piece of rubber, etc., starch indigestion could not be demonstrated in the test-meal, although it had existed before. To Fothergill is attributed the saying that "ferments are crutches." No doubt many an invalid would prefer walking on crutches rather than not at all. But there are many crutch-walkers, who by modern surgery have been enabled to throw away the crutches and walk unaided. So with the digestive ferments; they may be used with success temporarily, but the best thing to do is to discover how the patient may digest without them. And in case of amylaceous dyspepsia this is accomplished by cure of the excess of hydrochloric acid formation, or restoring the lost motor function of the stomach. For when the starchy foods are retained in the stomach overtime, they are very apt to cause an excessive secretion, or to produce an excessive amount of organic acid by fermenting in the stomach under the influence of bacteria.

In this connection it becomes a duty to warn against the use of *saccharin* as a substitute for sugar. As our nation is now engaged in the gigantic struggle to preserve its civilization, our government has found it necessary to restrict the sugar consumption. So far, fortunately, not under the caloric requirements for a human being. But to sweeten food and drink by saccharin is a mistake because this substance impairs the digestive power of the gastric juice — in fact, of all digestive ferments.

Instruction in Cooking Needed in American Schools.— One of the chief features in the treatment and also in the prevention of diseases of the stomach is the avoidance of improper medication and, what is even more important, of unsuitable diet. Much improvement is needed in American cooking and public kitchens and cooking schools might be of great benefit. Serious injury is being caused by insufficient or improper food. Instruction in cooking and diet should be given in all public schools where young girls attend. For nine out of 10 girls that attend these schools it will be a greater blessing, and they personally will prove a greater blessing to the community, if they know how to prepare a roast, boil potatoes and make an omelet or good bread, than if, ignorant in these things, they can give the most scholarly translation of Virgil. In Europe it is not considered below the dignity of daughters of the highest families, even those directly connected with royalty, to attend cooking schools. Nor is such an education incompatible with the best scientific and classical training. So the prevention of diseases of the stomach demands a wider and more thorough knowledge of the art of cooking. In addition to this, it necessitates a simpler life, closer adherence to the laws of nature, more freedom from business strain and nervous tension, and above all things the avoidance of excess in the use of alcoholic beverages and tobacco. Patients should be impressed with the fact that neither drugs nor any methods of treatment can improve them if they persist in their bad habits and faulty diet. Particularly must American business men, who, with admirable energy, but with little regard for their own health, persist in work too severe for their mental and physical constitutions, be taught that the prime factor in their successful treatment is rest. To such cases mental and physical rest is more essential to recovery than medicine or treatment directed to the stomach. Another factor which frequently leads up to stomach diseases is inactivity of the intestines, or constipation. This should in all cases of dyspepsia receive proper attention. When a person begins to feel distress after eating, or eructates, vomits, or has feelings of oppression, fulness or pain in the abdomen and headaches, one of the first treatments that is usually given by sympathizing friends is a drink of some alcoholic beverage. usually whiskey; then comes the abuse of pepsin; very frequently the abuse of some combination containing soda and mint, or some widely advertised panacea for the diseases of digestion. All this is generally being done in the entire absence of a correct recognition of the real disease. The safest thing for the patient to do in the absence of a logical diagnosis is to rest the stomach absolutely for 24 to 48 hours, and not take any food or medicine whatsoever; and thereafter, beginning with the very simplest kind of food — a small plate of farina, of strained oatmeal, a piece of toast, and a cup of hot milk and lime-water — proceed gradually to a cup of bouillon, and a small slice of lean boiled beef. Alcohol, sugars, rich and fatty substances should be avoided for a long time.



ANTERIOR VIEW.

(Dotted area shows location of Stomach.)

a. Lungs; *b.* Complemental pleural space: *c.* Liver; *d.* Transverse colon; *e.* Heart; *f.* Complemental pleural space.

Organic Diseases of the Stomach.—These are the various forms of gastritis (catarrh of stomach, ulcer, carcinoma, etc.) and the displacements and enlargements, dilatation. Displacements — gastroptosis — may be congenital or acquired. When the stomach is displaced from its normal position, the condition is in the great majority of cases accompanied with an infirmity of the general nervous system known as neurasthenia (q.v.). Stiller has pointed out that this condition in over 80 per cent of these cases is attended by the loose or floating 10th rib. Normally the 10th rib is attached to the costal cartilages, and these to the breast-bone. But whenever the stomach is displaced out of its normal position and a very diffused splashing sound is audible over the abdomen on shaking the stomach, there is, as a rule, a very movable or floating 10th rib.

Dilatations of the stomach may be primary, due to disease of the structure of the gastric walls. In these cases there is, as a rule, no mechanical interference at the outlet of the stomach, or such interferences are secondary to some obstruction at the outlet. The causes of this obstruction may be scars from old gastric ulcers; tumors, especially cancers; indurative chronic gastritis; or any peritonitic inflammation which may constrict the stomach from the outside. Frequently gall-stones which result in pericystic inflammation may constrict the part of the bowel immediately below the stomach in such a manner that it is indistinguishable from an obstruction of the pylorus. Five such cases are reported in 'Progressive Medicine,' by Prof. J. C. Hemmeter, December 1903, p. 45. So the cause of a dilated stomach is not always to be sought within the stomach itself.

A knowledge of displacements and dilations of the stomach necessarily precludes a knowledge of its normal position. This is admirably depicted in the accompanying illustrations where it is seen that the larger end of the stomach, or the blind pouch, may extend higher than the fifth rib, on the left side, thus reaching up behind the apex of the heart. This readily explains the distress felt about the heart, and also the irritable heart-action in some forms of gastric disturbance. The dorsal view of this illustration also shows the correct or normal relations of the 10th rib just referred to in connection with gastroptosis. When the 10th rib is detached or floating its tip sticks out like that of the 11th rib in this illustration. The same illustrations also demonstrate the anatomical fact that only a very small portion of the stomach is palpable through the soft part of the abdominal wall, when it is in normal position, because the larger part of it is concealed under the ribs and under the liver. So that the simple fact that we can see or feel a large part of the entire stomach projecting through the abdominal wall, when it is distended, is a sufficient evidence that the stomach is out of place. The stomach can be made visible through the abdominal wall by distending it artificially with carbon dioxide by means of an effervescent mixture containing tartaric acid and bicarbonate of soda. Hemmeter was the first to propose and use a method for locating and determining the size of the human stomach by successful use of the X-ray (*Boston Medic. and Surgic. Journal* 1897), and later another method for recognizing gastric ulcer by means of radiography ('Archives of Digestive Diseases,' Berlin 1906).

The remaining organic diseases of the stomach necessitates all the intricacies of chemical and microscopical diagnosis for their detection. They include the various forms of acute and chronic gastric catarrh or, as they should preferably be called, the forms of acute and chronic gastritis, the various types of gastric or peptic ulcers, the various tumors of the stomach, especially cancer, which is becoming more and more frequent. Then there are numerous diseases of a general nature, such as tuberculosis, typhoid fever, glanders, lymphadenoma and syphilis, to be considered in the study and treatment of disorders of the stomach.

When ever there is an organic disease of the stomach present it should be sought after with all the resources of modern clinical diagnosis. There should be no dallying with so-called stomach panaceas. Quite a number of the so-called incurable gastric diseases which have been allowed to go on to destruction of the glandular layer and absolute loss of peristalsis of the stomach are not incurable in themselves, but have become so from neglect, maltreatment, or procrastination. And even in those cases in which the practitioner is at present helpless, the rapid progress of medical art, especially as applicable to digestive diseases, promises a substantial gain in the near future.

Bibliography.— Hemmeter, ‘Diseases of the Stomach,’ in which there are 1,288 separate publications arranged categorically in separate chapters to which they refer especially, and over 1,000 references in the text; Ewald, ‘Diseases of the Stomach,’ translated into English by Morris Manges; Boas, ‘Diagnostik und Therapie der Magenkrankheiten’; Riegel, ‘Erkrankungen des Magens,’ being Vol. XVI of Nothnagel's ‘Encyclopedia on special Pathology and Therapy’; Stockton, ‘Diseases of the Stomach’; Fleiner, ‘Krankheiten der Verdauungsorgane’; Einhorn, ‘Diseases of the Stomach’; Martin, ‘Diseases of the Stomach’; Abercrombie, ‘Investigations on Diseases of the Stomach’; Habershon, ‘Diseases of the Abdomen’; Rosenheim, ‘Pathologie u. Therapie des Verdauung apparats’; Pick, ‘Magenkrankheiten’; Brouar del et Gilbert, ‘Traité de Médecine et de Therapeutique,’ Vol. IV; Mathieu, ‘Traité de Maladies de l'Estomac’ Hemmeter, ‘Organic Diseases of the Stomach’; Leo, ‘Krankheiten der Bauchorgane’; Robin, ‘Traité de Therapeutique appliquée,’ fasc. XII (article on indigestion by G. LeMoine).

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STOMACH-PUMP, a small pump or syringe used for removing matter from the stomach, for washing it out, or for injecting fluids into it. It resembles the common small syringe, except that there are two apertures near the end, instead of one, which, by means of valves in them opening different ways, serve respectively as a sucking and a forcing passage. When the object is to extract something from the stomach, the pump is worked while its sucking orifice is in connection with an elastic tube passed into the stomach; and the extracted matter escapes by the forcing orifice. When it is desired to throw cleansing water or other liquid into the stomach, the connection of the apertures and the tubes is reversed. A pump may not be always procurable when the occasion for it arises, and a simple tube will in many cases answer the purpose as well, if not better. If the tube be introduced and the body of the patient be so placed that the tube forms a downward channel from the stomach, all fluid matter will escape from the stomach by it, as water escapes from a funnel by its pipe; and if the outer end of the tube be immersed in liquid, there will be, during the discharge, a siphon action of some force. On changing the posture of the body, water may be poured in through the same tube to wash the stomach. For washing out the stomach a long flexible tube is also in common use, water being run in by means of a funnel attached to one end, and this end being afterward lowered so as to form the tube into a siphon.

STOMATA (Greek *stoma*, mouth), minute orifices or pores in the epidermis of leaves, etc., which open directly into the air cavities pervading the parenchyma. The stomata are also called the «automatic gateway.» See Leaves.

STOMATITIS. See Mouth, Diseases of the.

STONE, Amasa, American business man and philanthropist: b. Charlton, Mass., 27 April 1818; d. Cleveland, Ohio, 11 May 1883. At 21 he engaged in the construction of railroad bridges and railroads, and soon attained high rank among constructors. In 1846 he entered into a partnership for the building of the Cleveland, Columbus and Cincinnati Railroad; in 1850 he was president of that road and thenceforward resided in Cleveland. He was later engaged in the construction of the Cleveland and Erie Railroad; was managing director of the Lake Shore Railroad in 1872–74; and was president or director of several railroads and industrial corporations in Ohio. He gave largely to charitable institutions in Cleveland, and built and endowed an old ladies' home and an industrial school. He also gave to Western Reserve University, $600,000, on condition that the university should be moved from Hudson to Cleveland, and that the classical department should be named in memory of his son, Adelbert College. Consult ‘Amasa Stone, A Memorial’ (New York 1883).

STONE, Charles Pomeroy, American soldier: b. Greenfield, Mass., 30 Sept. 1822; d. New York 24 Jan. 1887. He was graduated from West Point in 1845; served in the Mexican War and was brevetted captain. He became chief of ordnance of the division of the Pacific and subsequently settled in California. At the opening of the Civil War he was an officer of volunteers in the Union army, but after a short term of service was arrested, and imprisoned in Fort Lafayette, New York harbor, February–August 1862. Upon his release he served in the Department of the Gulf, and was chief of staff to General Banks, 1864–64. Later in the year he resigned from the army and entered the service of the khedive of Egypt in 1870 where he rose from brigadier-general and chief of staff to be Ferik-Pasha (1873–83). He received numerous decorations and held confidential positions under the khedive. Returning to the United States he became the engineer in charge of building the foundation for the Statue of Liberty in New York harbor.

STONE, Edward James, English astronomer: b. London, 1831; d. Oxford, 1897. He was graduated from Queen's College, Cambridge, and in 1860 was appointed chief assistant at the Greenwich Observatory. In 1870 he was made royal astronomer at the Cape of Good Hope, in which position he prepared a catalogue of all stars to the 7th magnitude between the south pole and 25° S. declination. For this he was awarded the Lolande prize of the French Academy in 1881. This he supplemented in 1891 by a catalogue of all stars to the 7th magnitude between 25° S. declination and the equator (6424). In 1879 he was appointed Radcliffe observer at Oxford, a position he held till his death. Among his contributions to astronomical science were his deduction of the value of the solar parallax and his observation of the reversal of the Fraunhofer spectrum during an eclipse of the sun in 1874. Consult Royal Society, 'Catalogue of Scientific Papers' (London 1867–1902).

STONE, Ellen Maria, American missionary: b. Roxbury, Mass., 24 July 1846. She was a member of the staff of the 'Congregationalists' at Boston in 1867–68, in 1878 went to Samokov as a Congregational missionary, and was removed subsequently to Philippopolis, southern Bulgaria, and (1898) Salonica, Macedonia. In September 1901 she was kidnapped by brigands between Bansko and Djumia, Macedonia, and a ransom of $110,000 for her and Mme Tsilka, captured at the same time, was demanded. By subscription in the United States, $65,000 was raised and the release of the prisoners followed. Her narrative appeared as 'Six Months Among Brigands' in *McClure's* in May–October 1902, and in 1903 in book form. Later on she lectured in order to raise money for foreign missions. She also contributed to magazines and newspapers.

STONE, Frank, English painter: b. Manchester, 22 Aug. 1800; d. London, 18 Nov. 1859. He originally painted in water colors, and in 1837 became a contributor to the exhibitions of the Royal Academy. Subsequently for more than 20 years he produced many works in genre and history, and on subjects of sentiment and imagination. Some of these are well known by engravings, particularly the companion pieces entitled 'The First Appeal' and 'The Last Appeal,' once very popular. He was elected an associate of the Royal Academy in 1851.

STONE, Harlan Fiske, American law scholar and educator: b. Chesterfield, N. H., 11 Oct. 1872. He was graduated at Amherst College (1894), received the degree LL.B., Columbia University of Law (1898), and LL.D., Amherst (1913). He was admitted to the New York bar in 1898, was lecturer on law (1899–1902), professor of law (1902–05) and was dean from September 1910, of Columbia University School of Law. He is a member of the law firm of Satterlee, Canfield and Stone. He wrote 'Law and its Administration' (1915).

STONE, James Samuel, American Protestant Episcopal clergyman: b. England, 27 April 1852. He was graduated from the Philadelphia Divinity School 1877, took orders, and was rector of Saint Philip's Church, Toronto, 1879–82, of Saint Martin's Church, Montreal, 1882–86, of Grace Church, Philadelphia, 1886–95, and of Saint James' Church, Chicago, since 1895. He was made B.D., by the Cambridge Theological School, and D.D., by Bishop's College, Lennoxville, Canada. He has published 'Simple Sermons on Simple Subjects' (1879); 'The Heart of Merrie England' (1887); 'Readings in Church History' (1889); 'From Frankfort to Munich' (1894); 'Woods and Dale of Derbyshire' (1895); 'The Prayer before the Passion' (1911); 'The Passion of Christ' (1912); 'The Glory After the Passion' (1913); 'The Preparation for the Passion' (1915).

STONE, John Timothy, American Presbyterian clergyman: b. near Boston, 7 Sept. 1868. He was graduated (class orator) at Amherst College (1891) and at Auburn Theological Seminary (1894). Served as pastor at Utica (1894–96), Cortland, N. Y., (1896–1900), Brown Memorial Church, Baltimore (1900–09), and, since 1909, at Fourth Church, Chicago. He was moderator of the General Assembly of the Presbyterian Churches in United States, 1913–14 and president of trustees of the College of Wooster from 1917. During the World War he was Captain-Chaplain of Illinois Reserve Militia, First Infantry, and director of Y. M. C. A. religious work at Camp Grant, Ill. He has written 'Footsteps in a Parish' (1908); 'Recruiting for Christ' (1910), as well as monographs on themes educational and religious.

STONE, Lucy Blackwell, American reformer: b. West Brookfield, Mass., 13 Aug. 1818; d. Boston, 18 Oct. 1893. She was graduated at Oberlin College in 1847 and in 1855 was married to Dr. Henry B. Blackwell, retaining, however, her own name. In 1848 she toured the New England States and Canada lecturing against slavery. In 1869 she helped organize the American Woman's Suffrage Association of which she was president until 1872; became connected with the *Women's Journal* in 1872, and was editor after 1888. Her lectures on woman suffrage made her known throughout the country.

STONE, Marcus, English painter: b. London, 4 July 1840. He is a son of Frank Stone, A.R.A. He learned his art in his father's studio; exhibited his first picture in 1858 in the Academy, of which he became an associate in 1877, being elected an academician in 1887. Among his better-known pictures are 'Claudio Accuses Hero'; 'On the Road from Waterloo to Paris'; 'Stealing the Keys'; 'Henry VIII, and Anne Boleyn'; 'Sain et Sauf'; 'Il y en a toujours un autre'; 'A Gambler's Wife'; and 'The First Love Letter.' Many of his pictures have been published as engravings and in this form have become well known to the public.

STONE, Marvin Chester, American inventor: b. Portage County, Ohio, 1842; d. Washington, D. C., 17 May 1899. He invented several small articles, and afterward discovered a method of imitating, in colored china, the famous «peach-blow» vase. He acquired a large fortune, and during his later years was engaged in many philanthropic undertakings.

STONE, Melville Elijah, American journalist: b. Hudson, Ill., 22 Aug. 1848. He began his journalistic career on the Chicago *Tribune*, but was not permanently settled in it until 1871, when he established the Chicago *Daily News*. In 1881, with Victor F. Lawson, he acquired the Chicago *Morning News*, changing its name to the *Record*. In 1888 he retired temporarily from newspaper work, and spent some years in Europe, and upon his return entered the banking business, organizing the Globe National Bank (1891) of which he was president until its consolidation with the Continental Bank in 1898, when he became general manager of the Associated Press.

STONE, Ormond, American astronomer: b. Pekin, Ill., 11 Jan. 1847. He was educated at the University of Chicago, and in 1870 was made assistant astronomer at the Naval Observatory at Washington. From 1875 to 1882 he had charge of the Cincinnati Observatory superintending among other works an extended series of measures of Southern double Stars. From 1882 to 1912 he was professor of astronomy and director of the observatory at the University of Virginia, where he devoted himself principally to the observation of nebulæ and variable stars. As a teacher he trained a large number of astronomers. He founded and edited the *Annals of Mathematics;* contributed to various scientific journals, and devoted much of his time to the cause of public education. In 1912 he retired on a pension from the Carnegie Foundation.

STONE, Thomas, American patriot, signer of the Declaration of Independence: b. Pointon Manor, Charles County, Md., 1743; d. 5 Oct. 1787. He studied law at Annapolis, and began to practice at Frederickton in 1764. He was a delegate to the Continental Congress in 1775–77, and served as a member of the Committee on Confederation (1776–77). In 1777 he urged Maryland to ratify the Articles of Confederation, which, however, the State did not do until three years later. In 1783–84 Stone was again a delegate to the Continental Congress, and in the latter year acted as president *pro tempore.* Consult Sanderson, 'Signers of the Declaration of Independence,' Vol. IX (1823–27).

STONE, Walter King, American illustrator: b. Barnard, N. Y., 2 March 1875. He was educated at the Rochester public schools, studied at Rochester Mechanics' Institute and Pratt Institute, Brooklyn. He has been illustrator and designer for *Century, Harper's. Scribner's, American, Delineator,* etc., besides designing numerous book-covers.

STONE, Warren Sanford, American labor leader: b. Ainsworth, Iowa, 1 Feb. 1860. He was educated at Washington Academy and Western College. He started service (1879) with the Rock Island system railroad as fireman and was promoted to engineer in 1884. He was appointed (1903) grand chief of the International Brotherhood of Locomotive Engineers (succeeding grand chief Arthur) and has held this office ever since. He is a member of the Industrial Peace Commission.

STONE, William Joel, American lawyer and statesman: b. near Richmond, Ky., 7 May 1848. He studied law and was admitted to the bar in 1869 and began to practice at Nevada, Mo., in partnership with Judge C. R. Scott. In 1872 he was elected prosecuting attorney at Vernon County. He was Democratic Congressman from the 12th Missouri district from 1884–90, and was elected governor of Missouri in 1892. In 1903 he was elected to the United States Senate receiving re-election 1908 and 1914. He became chairman of the committee on foreign relations after 1913 and was one of those few who advocated that Americans should be warned against sailing on ships of the belligerents.

STONE, William Leete, American historical writer: b. New York, 4 April 1835; d. Mount Vernon, N. Y., 11 June 1908. He graduated from Brown University in 1858 and in 1859 was admitted to the bar. He was centennial historian for New York and made the speech at Independence Hall, 10 May 1876. He published 'The Life and Times of Sir William Johnson, Bart'; 'Revolutionary Letters'; 'History of New York City'; 'The Saratoga Battle Grounds'; and 'Life of Governor George Clinton.'

STONE, Witmer, American naturalist: b. Philadelphia, 22 Sept. 1866. He was educated at the University of Pennsylvania, and was assistant curator in charge of the museum of the Academy of Natural sciences, Philadelphia. He has published 'Birds of Eastern Pennsylvania and New Jersey' (1894); 'Mammals of New Jersey' (1908); 'Birds of New Jersey' (1909); 'Flora of Southern New Jersey' (1912); 'Birds of Yucatan and Southern Mexico'; 'The Molting of Birds', etc.

STONE. (1) A small piece or fragment of rock; a piece of rock adapted in size and shape for a specific purpose, as for building, etc. (See Building Materials; Rocks; Granite; Mineral Production of the United States). (2) In medicine, a calculous concretion in the bladder, kidney, etc. (See Calculus). (3) A denomination of weight. See Weights and Measures.

STONE, Artificial. See Cement; Concrete; Masonry.

STONE AGE, the name given to that period in the development of prehistoric mankind when stone, bone, shells and wood were the only materials employed as tools, weapons, and implements. The term first came into recognized use by the publication in 1865 of 'Prehistoric Times,' written by Sir John Lubbock (Lord Avebury), who compiled and set in order the discoveries made in France and elsewhere during the previous half century. He classified the prehistoric period into three divisions, namely: *Iron Age,* when bronze, copper and stone were superseded by iron in most instruments and weapons, continuing to the present; *Bronze Age,* preceding the use of iron, when bronze was the predominant material; and *Stone Age,* still earlier, in which, until near its close, no metal was made use of by men.

The Stone Age was further divided by Lubbock into 1. *Paleolithic,* Old Stone Age, the more ancient time of chipped stone implements; and 2. *Neolithic,* New Stone Age, the more recent time of polished stone implements. This classification persists, but further collection of materials has enabled archæologists to define several subdivisions, especially in the Paleolithic part, marking successive changes in the population and advances in culture, at least in southern and western Europe. Elsewhere there seems never to have been such a concentration of primitive humanity, nor have its remains been so thoroughly studied; nevertheless it is possible in a general way to arrange the facts gathered in all parts of the world into the European culture-scheme. Chronologically, however, this cannot be done. Some peoples learned how to smelt and forge iron long before others; bronze was made and cast in some countries earlier than in others; and meanwhile races and tribes elsewhere continued in ignorance of either. In fact, savage peoples in remote corners of the world remain in the Stone Age to the present time, and will continue to do so indefinitely, except for such improvements as they may adopt from more enlightened neighbors. The succession of stages in cultural evolution to be outlined in this article nevertheless accords with the truth as applied to any one region or race, because there is never a retrogression from a higher to a lower stage. At the same time it seems probable that the significant advances were not often, if ever, by slow evolution, but rather were owing to the conquest and occupation of each country by strangers bringing some superior degree of culture.

Paleolithic or Old Stone Age.— It is hardly a century since the chance finding of an arrowhead unmistakably of human workmanship (i.e. an artifact) deep in the gravel of the Somme Valley, in France, led to an immediate and lively interest in the new science of prehistoric anthropology, and to extended explorations not only in France but all over the world. This soon resulted in large collections of objects picked up on the surface, taken from various depths in river-sands and gravel-deposits, or found in caves, peat-bogs, graves, etc. These were attentively studied not only with reference to material, form and possible purpose, but in the light of geography and geology, in order to determine their relative age. The determination of the geological position in which each relic was found was particularly important. The general result of 50 years of study has been the perception and arrangement of the following series of culture-groups, or «stages», within the Paleolithic period, numbered from the oldest (1) to the most recent (8):

8. Azilian-Tardenoisian
7. Magdelenian
6. Solutrean
5. Aurignacian
4. Mousterian
3. Acheulian
2. Chellean
1. Prechellean

A brief account of the geological record is here necessary in order to place the earliest traces of man in the Stone Age in proper perspective. All readers are probably acquainted with the fact that an era of intermittent glaciation that in its maximum effects covered nearly all of the northern hemisphere with an arctic climate and thick ice, intervened between the close of the Tertiary (Pleistocene division) and the beginning of the Quaternary era, which latter immediately preceded the present conditions. This Glacial Period, as it is termed, is now known to have been not continuous, but to have had — at any rate in Europe — three breaks, during which intervals the ice disappeared and a mild climate prevailed. This amelioration was most marked following the second ice-period, when for an immensely long time both Europe and North America were restored to a climate and appearance not greatly different from the present. Forests and vegetation were much the same as now, and most of the animals, with the addition (perhaps implying a somewhat warmer climate) of hippopotami, elephants, rhinoceroses, lions, and some other now tropical species, all long ago extinct.

Eolithic Relics.— In geological formations of this «Eolithic» time have been found rudely chipped and hammered stones that are regarded by most archæologists as true artifacts, and are called «eoliths.» It is very likely that some of them are really of human handiwork; and it is believed by many persons that an indication of their makers is given by the discovery, in 1907, deep in a gravel-bed near Piltdown in Kent, England, of a broken, fossilized skull having human characteristics. Piltdown is on a plateau abounding in eolithic flints and broken pebbles. This skull has been the subject of intense study and discussion. All its features, as well as the brain capacity, denote a being inferior to any other prehistoric race known; but its relationship to them, or to the more recent inhabitants of the globe, remains undetermined; it is not, in fact, fully conceded to be anything but the braincase of an anthropoid ape. These rude relics of the dawn of humanity mark the *Pre-Chellean* stage; and the situation implied would be dubious were it not that in some places the accompanying implements are convincingly of human workmanship, and were it not that an indubitable relic of a human frame has been exhumed: for in the sands of Maurer, near Heidelberg, Germany, there was found, in 1907, a human lower jaw, which is the oldest or earliest known representative of the human race. This Heidelberg man (*Homo heidelbergensis*) had many apelike features, but he was unmistakably human, and his period is estimated at 250,000 years ago.

Pre-Chelleans.— This long warm period was followed by one of great aridity, changing latterly into a moist, cooling phase that brought a renewed glaciation, which, however, did not extend nearly as far toward the south as has the earlier ones; and after a time the glaciers again retreated, and a third warm stage renewed livable conditions throughout the North Temperate Zone, so that southern Europe and northern Africa again became occupied by human inhabitants. They were nomadic savages, no doubt, wandering along the river courses; and they possessed so little ingenuity that they were able to improve very little the shapely pebbles, or accidentally fractured flints and other sharp-edged stones that they picked up and tried to use as aids to their hands. That these rude Pre-Chellean forerunners of mankind existed for an immensely long time, and became widely diffused, is shown by the fact that in every part of the world their rough implements are to be found, substantially alike whatever the region.

Chellean Stage.— The first indication of advance is that stage called *Chellean*, in which men had not only improved in the shaping of flint pieces to service, but invented new tools. Its characteristic implement is the «hand-ax» (*coup de poing*, of the French), in which an elongated pebble of flint or quartzite was flaked by chipping it on both sides to a point at one end, while usually the natural roundness of the stone was left at the other. This tool was roughly almond-shaped, of any convenient size, and was grasped in the palm of the hand, it having no other sort of a handle.

Acheulian Stage.—A more advanced stage of this industry is marked particularly by the earliest evidence of knowledge how to kindle a fire — probably the most momentous single discovery in human history. The flaked flints and other worked-stones of this culture-stage are much superior in both form and variety of utility to those of the Chellean, and represent a really remarkable advance in intellectuality and in breadth of life. This Acheulian period was brought to an end, slowly but steadily, by the approach of the fourth recurrence of glacial cold in Europe, after a third interglacial, or warm, interval of about 125,000 years, during which man had progressed in industry from Pre-Chellean inability to the excellence of Acheulian productions, which imply a very considerable elevation above a mere animal existence.

Mousterian Stage.— The arid and steadily cooling climate of Acheulian times was followed, as has been stated, by a fourth glaciation, equivalent to what in North America was the last and greatest "glacial period," when one ice-cap covered all Europe north of the Baltic, and another spread far outward from the Alps; and the climate was, of course, exceedingly cold. This is the "Reindeer Period" of the older writers on prehistoric antiquities, a name suitable enough since that and other boreal animals characterized the semi-arctic fauna of all the North Temperate Zone. During this cold time, estimated to have lasted 25,000 years, man continued to exist in what is termed the *Mousterian* stage of culture; but under the hard conditions of life at that time mankind deteriorated, judging by the inferiority of his tools as compared with those of his Acheulian predecessors. His relics are found most abundantly in southern Europe, and in caves, which were then first resorted to as permanent human habitations, the wintry weather driving men to seek their snug shelter. The Mousterian, then, is the true "cave-man." What he was like is known from a great number of skulls and other parts of skeletons exhumed from cave-floors and other subterranean deposits of this time. The first important find of the kind was in 1856 in a grotto in the Neanderthal (Neander Valley) near Dusseldorf, Rhenish Prussia; but since then skulls and other bones in excellent preservation have been procured at Canstatt in Germany, Spy in Belgium, Sipka in Moravia, Krapina in Croatia, and at many places in southern France, especially in the caves at Le Moustier in Dordogne, from which the period derives its name.

Neanderthal Cave-Dwellers. — Southern France, a limestone region, is honeycombed with caves (see CAVE-DWELLERS), and seems to have been the most populous centre of the Neanderthals (q.v.) — an intermediate race that extended from England to Hungary, at least, and were the typical savages of Paleolithic times. They were men of a species (*Homo neanderthalensis*) superior to the Heidelberg type of Chellean times (possibly their ancestor), but retained apelike characteristics, and certainly were far inferior in physique, as in mind, to the Neolithic men, presently to be described. The skull of the Neanderthal man was characterized by an extremely receding forehead, by the great ridges of bone above the eyes, a massive jaw with little chin, and very strong teeth and chewing-muscles, indicating that these ancient people were meat-eaters. They were men of stocky, robust frames, averaging about five feet and four inches in height, but they had not yet acquired a fully erect attitude of body.

The relics of the earlier part of the Mousterian period show little advance over the preceding culture; but later the increased employment of the sharp, knife-like flint-flake, retouched on one side only, is observable, and a gradual increase in the making of different hunting-weapons, and of small awls, scrapers and so forth, of stone and bone, and of needles necessary to sewing the skin clothing required in the colder weather of that time as compared with the era of their remote forefathers. Is it not possible that the improvement noted may be the result of the greater wants to be filled, and energy required thereby, owing to the increased difficulty of maintaining existence and comfort in a cold world? No evidence that these cave-men had or knew of the bow and arrow has yet come to light.

As the glaciers of this Mousterian period of cold, which lasted many thousands of years, melted, returning warmth of climate introduced the post-glacial conditions that with minor changes have continued to the present. It was at this juncture that the Neanderthal race came to an end, and did so with a relative suddenness that is astonishing. The latest student of the matter, Prof. H. F. Osborn, regards it as a case of the complete extinction of a species. "So far as we know at present," he declares, "the Neanderthals were entirely eliminated; no trace of the survival of the pure Neanderthal type has been found in any of the Upper-Paleolithic burial-sites." With their disappearance ends the Mousterian stage, and the Lower-Paleolithic period.

The Upper Paleolithic.— In the strata overlying that in which the relics of the Mousterian or Cave-man culture are found, lie the evidences of a new and different kind of industry, which introduces the Upper-Paleolithic division of the Old Stone Age.

This is known as the *Aurignacian* culture, and is attributed to the immigration into western Europe of a race of men, probably from the southeast, as Aurignacian relics are found on all the shores around the Mediterranean Sea. The inroad of these foreign and better-armed people was followed by the destruction of the race of Cave-men, whose grottoes and rock-shelters were adopted as homes by their conquerors. This happened, it is believed, between 25,000 and 30,000 years ago. Who were these strangers? Whence did they come? It is believed that they were Asiatics who had slowly worked their way westward chiefly, if not wholly, along the southern shore of the Mediterranean into and beyond Spain. They were true *men* — *Homo sapiens* — not intermediate in structure and ability between human and simian, as were their predecessors in Europe. In short they are the ancestors of a large part of the men of to-day, and it is unfortunate that they are not known by a better name than "Cro-Magnons"— the designation of the cave in Dordogne, France, where their first-known skeletons were obtained. They were tall, well-built men, with heads long fore and aft (dolichocephalic), and with broad faces, pleasing features and well-developed chins. Probably the complexion of the skin was dark. They were men of large brains, a race, in Osborn's opinion, "capable of ideas, of reasoning, of imagination, and more highly endowed with artistic sense and ability than any uncivilized race which has ever been discovered." A large volume would be needed to describe thoroughly all of their industrial and social life as shown by the relics of the four successive stages of culture into which their long history has been divided by archæologists. It must be summarized here in a few paragraphs.

The Cro-Magnons.—The Cro-Magnons were essentially hunters, living on the flesh of wild beasts, including the mammoth, an extinct rhinoceros (elasmothere), aurochs, wild horse and other animals of the forests and plains. They dwelt not only in caves and rock-shelters but in great winter-camps, where they built clusters of houses made of timbers and covered with hides, many sketches of which they have left for our information. But they were nomads, and in summer wandered in hunting and fishing bands, for there is no evidence that agriculture was practised. They had excellent weapons of chipped stone for both warfare and hunting, and probably used bows and arrows. They made various hooks and spears for fishing, and tools of stone, bone and horn for the preparation of skins, for sewing and other household purposes; but they made no pottery. In some regions they advanced in culture more than elsewhere. They spread in Aurignacian times from the upper Danube in the East to Belgium and Britain in the West, but southern France was the most populous. There it was that their life came to be most settled, and the extraordinary art that distinguished the Aurignacian time was most highly developed. The soil of the caves occupied by the people of this period, and the sites of their camping-places, abound in small flint-flakes carefully pointed into delicate engraving tools — among them one shaped just like a modern burin. It was with these gravers that they cut from ivory and soapstone statuettes of animal and human figures, or incised on slabs of slate, tusks, flat bones, antlers, and especially on the walls of grottoes, pictures of the beasts about them, scenes of the chase, drawings of their houses, etc., sketched not only with startling fidelity to nature but with an artistic sense marvelous in the circumstances. They had a love of beauty, an instinct for true art, which led them to try to ornament everything they used; and this art was steadily cultivated and developed until it reached its astonishing culmination in Magdalenian times. The cutting out of figures in bas-relief from stone surfaces (usually a cavern wall), and the modeling of statuettes, are distinctively Aurignacian; and in this stage, also, painting had its birth, for many of the colored drawings that adorn the walls and ceilings of the caves date from this period — for examples, the red-outlined bison and aurochs in the grotto of Castillo, Spain, and the spirited drawings in red ochre of the woolly rhinoceros, and of a stag in the cave at Font de Gaume, France. In many cases the Aurignacian artist carved the outlines and distinguishing features of his subject in deeply incised lines, with minute attention to characteristic details. Therefore zoologists find some of these portraits of animals valuable to them, particularly with reference to the history of horses in Europe. The picture whose outlines were thus engraved was then coated with a reddish or yellowish paint composed of ochre and manganese mixed on a palette of schist.

Solutrean Culture.— The Aurignacian stage was succeeded by the *Solutrean*. This horizon is distinguished by the presence in its remains of the most delicately and perfectly worked leaf-shaped flints for knives, heads of spears, javelins and arrows, and in general by a sudden great improvement in the manufacture and design of all objects made of flint or quartz. This skilful culture, evidences of which are spread from the lower Danube Valley to the Bay of Biscay, is believed to be the product of fresh immigration of people from the teeming East, who moved westward along the northern border of the Black Sea and advanced up the Danube Valley and finally became predominant in southern Europe; yet it seems plain that the Cro-Magnons were not utterly destroyed even there, and that both in northern Europe and south of the Pyrenees they persisted in force. These invading Solutrean folks, who take their name from a vast camp, ringed with the turf-covered bones of tens of thousands of horses, slaughtered for food, near Solutré in southern France, were a practical people, ruder than those they had overcome, and during their time art declined.

Magdalenian Culture.— Comparative refinement revived, however, during the succeeding stage, the Magdalenian, when art was developed to its highest perfection in prehistory. Whatever may have been the racial character of the Solutrean people, the Magdalenean folk were unquestionably of Cro-Magnon stock. What was the occasion of the change that archæologists note at this point can only be conjectured, but the fact is plain. These Magdalenian Cro-Magnons attained in this period their highest culture and widest dispersion of the race. They have been traced northward to England and central Belgium, and eastward throughout central Germany, but never, apparently, colonized Italy or southern Spain. They were, as before, a nomadic and hunter people; but by this time the cold, wet climate had gradually softened into a warmer and drying one, and the growth of dense forests everywhere made the chase more and more difficult and arduous. Moreover the animals going in herds, such as the reindeer, wild cattle and horses, that needed large open grazing areas, had departed. In conformity with this the Magdalenians gradually became less nomadic, and depended more on fishing than on hunting for subsistence. Under these sedentary and softening influences the craft of the flintworker declined, for only poor and simple kinds of stone implements are recovered from village-sites of this time of decay; but the village-sites yield great numbers of skilfully contrived hooks, harpoon-heads, and other fishing-tools, chiefly made of bone. The style is quite new, and now are first seen round and barbed bone spearheads, the earliest with only an experimental barb, but later always furnished with rows of recurved barbs along their sides.

In this quieter life, where in the long-settled, favorable and populous districts of southern France and the neighboring border of Spain the people must have obtained a firm tribal organization, the Magdalenians acquired that power of draftsmanship, sculpture and painting that has astonished the critical world, and has been illustrated so thoroughly in several recent books, as those of Sollas, Elliot and Osborn, and in the Annual Reports of the Smithsonian Institution, not to mention the many learned writings in French, Spanish and German. Nearly all the finest painting of this period as well as that of the Aurignacian artists is on the walls and ceilings of deep and totally dark caverns — a fact that has caused much speculation as to the motive that carried such art into places where the work could be made or observed only by lamplight. «It would appear,» remarks Osborn, «that the love of art for art's sake . . . together with the fine spaces which these caverns alone afforded for large representations, may be an alternative explanation.»

Azilian-Tardenoisian Invasion.— The decline of the Cro-Magnons may have been owing largely to environmental causes; but it may have been accelerated by the arrival, probably occasioning long battling, of two streams of newcomers, one of which, known as the Azilians, spread all over France and Belgium, and the other, the Tardenois, occupied Spain at first, but gradually coalesced with the other. Their flints are small and peculiar, totally unlike anything used by the Cro-Magnons. This may have been the result of a necessary change in the character of hunting weapons, for now southern Europe was covered with heavy forests, the reindeer had retreated to the North and the stag was the principal game-animal; in fact the people seem to have depended mainly on fishing for subsistence. The climate was still cool and moist, and therefore the use of caves and rock-shelters continued, but otherwise the habits and culture of these final races of Paleolithic man in southern Europe were totally different from, without being much in advance of those of the Magdalenians. Who were these final Paleoliths? The Azilians were a brachycephalic people, the first of that type to appear in the West; and it is believed that they may represent the first-comers of the Alpine, or Celtic, race of modern ethnology. They are often designated as the Furfooz stock. The other was a long-and-narrow-headed race that came in from northern Africa via Spain, and are thought to represent the earliest indication of what Sergi calls the Mediterranean race. It is evident that both were mentally superior to, and more broadly cultivated than, the Cro-Magnons, except in artistic matters, and subdued the latter completely; yet there is evidence that in southern France, at least, large communities of Cro-Magnons continued to live and develop, and have persisted there to the present day. After a few centuries, however, these Azilian-Tardenois men, the last of the purely hunting-races, themselves suffered displacement by the incoming of a more advanced people moving westward along the great Mediterranean highway of migration, and with their disappearance the Old Stone Age comes to an end.

Neolithic, or the Age of Polished Stone.— The notion formerly prevalent that there was a sudden clearing away of Paleolithic men and things, and an equally sudden supercession of Neolithic people and culture, has been abandoned before the progress of information. Men in different parts of the world have always advanced toward better conditions at an unequal pace; and in most cases, as, for example, our North American Indians, who at the time of their discovery by Europeans were in the Neolithic stage, no evidence can be found of just how or when the advanced step was taken. In southern Europe, where circumstances favor a clearer local understanding of prehistory, it appears probable that between 7,000 and 10,000 years ago strangers began to filter in from the eastward along the Mediterranean shores, and to settle in selected spots; and that this process went on — not always peacefully, we may imagine — until the inferior occupiers of the land had been displaced, or absorbed and educated, and the superior culture was generally established — a matter probably of a few centuries. These immigrant conquerors, who brought with them new arts of life, and dispossessed the wandering hunters, introduced in western Europe the Neolithic Age. Whether a similar conquest or a more peaceful process of intellectual development produced the same result in other parts of the world remains to be discovered. In the earlier part of their history, at least, the Neolithic men continued to make and use strong hatchets, picks, flake-knives, etc., of flint and quartz, but the patterns were more serviceable; and they introduced an entirely new article in the stout axe, the chisel-like 'celt,' and other tools made of granite, jasper and other tough rocks, and formed by hammering, grinding, and then, often, polishing. This is the distinctive mark of the Neolithic period, but other dstinctive innovations followed, of which the most important, socially, perhaps, was the making of pottery. They had the rudiments of agriculture, had domesticated the dog and ox and pig, refused to hunt horses for food but captured and tamed them; and to carry on these domestic industries they were settled in defensive houses and villages, an excelllent idea of which may be had from the remains of their lacustrine towns (see LAKE-DWELLERS) in Switzerland and Italy. This article may fitly be closed by a comprehensive extract from Boyd Dawkins's standard work 'Early Man in Britain': «The arts of spinning, weaving, mining and pottery-making were known, and that of boat-building had advanced sufficiently far to allow of voyages being made from France to Britain, and from Britain to Ireland. Traffic was carried on by barter and stone axes were distributed over areas far away from those in which the stone was found. Tombs also were built, some of imposing grandeur, for the habitation of the dead in the after-world, in which the spirits were supposed to lead a life not very different from that of the living, and at which they were worshipped by the family or tribe, after the manner of the red Indians and many African peoples. . . . The neolithic civilization was long established, and underwent so little change, if any, in the lapse of ages that no traces of a change have been preserved to our times. Its duration varied in different countries, and it yielded place to a higher culture in Greece and Italy long before it passed away from central and northern Europe.»

Bibliography.— Some of the most recent books in English are listed below. In most of them, especially those of Osborn and Sollas, will be found extensive references to other works, especially those by original investigators in France, Belgium and Germany. Dawkins, B., 'Early Man in Britain' (London 1883); Ripley, W. Z., 'Races of Europe' (New York 1899); Avebury, Lord, 'Prehistoric Times' (revised edition, New York 1913); Keith, A., 'Antiquity of Man' (London 1915); Parkyn, E. A., 'Prehistoric Art' (London 1915); Sollas, W. J., 'Ancient Hunters' (London 1915); Osborn, H. F., 'Men of the Old Stone Age' (New York 1916); Spurrell, H. G. F., 'Modern Man and His Forerunners' (London 1917).

ERNEST INGERSOLL.

STONE CIRCLES, circles of standing stones and of small boulders, found throughout Great Britain and in some places on the continents of Europe, Asia and Africa. See STONES, STANDING.

STONE COAL, a name used to some extent in the United States and in England for anthracite coal to distinguish it from soft coal or bituminous coal. On the continent of Europe it is more frequently used to distinguish the older (Carbonic) coals form the later Mesozoic and Cenozoic coals and lignites.

STONE-CROP, a plant, also called live-for-ever. See SEDUM.

STONE-CUTTING AND -DRESSING. This is the art of shaping, fitting, smoothing and finishing quarried stone, for use in masonry, foundations of monuments, arches, etc. (For the preliminary steps of taking out the stone see QUARRYING; DRILL AND DRILLING, the drill being one of the most important machines used in quarrying stone). Stone-cutting is more than a mechanical operation; it involves theoretical and geometrical calculations. The study of these is often termed Stereotomy. It involves some knowledge of architecture, and very exact calculations. Suppose that stones are required to be cut for an arch of 100 feet span and 25 feet rise. The exact curve and angle of each particular stone must be determined geometrically, and drawings made to guide the cutter. In the case of massive stone fronts for buildings, in which perhaps carvings occur, the design must be first perfected on paper, and sometimes models are made of more intricate parts. When dealing with angles the stone-cutter speaks of a batter of one in 10, meaning that there is a change of angle of one inch in width in 10 inches of length. Or he will specify a one in five rise, indicating the angle above the horizontal.

The primary tools of the stone-cutter are heavy hammers and chisels, the latter being operated with wooden mallets. By striking a stone a number of heavy blows with an edged hammer, along a given line, it will break approximately on that line. The more valuable stones, as imported marbles, are sawed, to avoid waste of material. For knocking off projections of stones from the quarry, a blunt double-faced hammer is used, of perhaps 20 to 30 pounds weight. Next, for roughly shaping, the face hammer may be employed, this tool having one blunt and one sharp face, and weighing ordinarily 20 to 25 pounds. The cavil, having one blunt and one pyramidal point, is also useful for rough dressing, and is somewhat lighter than the face hammer. The mason's pick is straight, double pointed, and commonly 18 inches long. It is useful for rough-dressing soft stone. The mason's axe or pean-hammer has two cutting edges, of three to four inches wide. It is useful after the cavil, to prepare the stone for the patent hammer. The tooth-axe has a serrated double head and is not suited to very hard stone. The bush hammer has a head made of a series (as 36) of steel pyramidal points bound together; the points vary in size according to the work to be done. The Crandall and the patent hammer are forms of steel blades or chisels clamped together and used for finishing. Hand hammers, mallets and chisels complete the common tools of the mason for hand dressing. Chisels are named as tooth-chisels, splitting chisels and pitching chisels, the latter being used in forming a straight square edge on a stone. Short-handled, heavy mallets are employed with the chisels. In using a stone chisel, it has to be directed at such an angle as will break off the weaker part of the stone. The knack of this is soon learned, and the experienced stone-cutter will remove with each blow almost exactly what he calculates on doing. For rapid stone-cutting, pneumatic tools are now employed. The pneumatic hammer, operated like the familiar pneumatic rivetter, is very speedy in operation. Pneumatic plug drills and bushing tools are made and operated on the same principle, air pressure supplying force for the blow, and a spring returning the tool to position. Portable surfacing machines are used on large stones, an adjustable arm being swung over the stone, and aligned to the work. Any one of a variety of surfacing tools may be inserted in the tool carrier, and when the compressed air is turned on the tool pounds away at a fixed level under the guidance of the operator, who directs it over the entire surface requiring to be dressed. The stone saw is commonly employed for cutting up marble and sandstone. The cuts made are not quite smooth, and may be rubbed off with a slab and grit, operated by hand or power with water. Consult French, 'Stereotomy' (1906); Warren, 'Problems in Stone Cutting' (1911); Howe, 'Masonry' (1915).

STONE OF DESTINY. See LIA-FAIL.

STONE FERRY, Battle of. During the Revolutionary War an engagement took place here (20 June 1779) between the small entrenched force of British troops under Lieutenant-Colonel Maitland and a much larger body of the American forces under General Lincoln; the latter's attack was repulsed and Lincoln was obliged to withdraw as General Moultrie had failed to carry out the orders for preparedness and fresh forces came from the John's Island garrison of Britishers. The Americans sustained a loss of about 150 and the British about 130.

STONE-FLY, an aquatic neuropterous insect, much used as a bait in trout-fishing by anglers. These flies belong to the platypterous sub-order *Perlaria*, recognized by the hinder wings being of large size, and folded, while the tarsi are three-jointed, and the antennæ or feelers are filamentary in nature. The abdomen is provided with a pair of long-jointed caudal appendages. The mandibles are rudimentary. These flies and their larvæ occur plentifully in the neighborhood of lakes and ponds. They are carnivorous, and the larvæ are aquatic.

STONE MOUNTAIN, a dome-shaped hill of granite in De Kalb County, Ga., rising about 700 feet above the surrounding level, and covering an area of about two square miles; also a town near by. The northern face of Stone Mountain is precipitous, its base presenting an almost vertical cliff 300 feet in height; but the other sides have a more gentle slope. The dome is everywhere naked rock, except where here and there a few hollows have permitted a little soil to accumulate, and some trees and shrubs to take root. Its visible bulk is estimated to contain seven and a half billions of cubic feet of dark granite, which is quarried from the northeastern foot. An electric road recently constructed from the neighboring town has made the rock a pleasure-resort, a path leading to its summit from the terminus. A plan has been made for the carving on the vertical northern face of the mountain of a series of gigantic figures representing scenes in the Civil War. This project would require a vast amount of time and money, and has been protested by many persons on the ground that its execution would detract from rather than enhance the interest of an extraordinary natural object.

STONE-PINE, a pine (*Pinus pinea*), common in the south of Italy, and often introduced into pictures of Italian landscapes. See PINE.

STONE RIVER, or MURFREESBORO, Battle of. After the battle of Perryville (q.v.) 7–8 Oct. 1862, and General Bragg's retreat from Kentucky into East Tennessee, Bragg was authorized by the Confederate government to make a movement into Middle Tennessee, and late in November had gathered his army at and near Murfreesboro, on Stone River, 33 miles southeast of Nashville. Wheeler's cavalry covered his front, its pickets within 10 miles of Nashville.

Gen. W. S. Rosecrans, who had succeeded General Buell in command of the Army of the Ohio, 27 October, made some changes in the organization of the army, henceforth to be known as the Army of the Cumberland; which was composed of the 14th Army corps. The corps was divided into three wings; the right wing, of three divisions, under Gen. A. McD. McCook, the centre of five divisions, under Gen. Geo. H. Thomas, and the left wing, three divisions, under Gen. T. L. Crittenden. On 26 December Rosecrans, with 56,000 men, advanced from Nashville in three columns, the right, under McCook, by the Nolensville pike, the centre, under Thomas, first on McCook's right by the Franklin pike and subsequently on his left; and the left, under Crittenden, by the Murfreesboro turnpike. Opposition was encountered from Wheeler's cavalry and Bragg's outposts at Nolensville, La Vergne and Stewart's Creek bridge; and there was some delay caused by rain and bad roads; but at night of the 29th Crittenden was close up to Murfreesboro, and under Rosecrans' orders to occupy the place he threw a brigade across Stone River, two brigades were crossing the stream, and two divisions were under orders to follow, when the movement was suspended by Rosecrans, and the brigade recalled, after a sharp skirmish with a brigade of Bragg's troops. Thomas came up on Crittenden's right, but McCook was delayed until the next day, and after some severe fighting, in which he lost 135 killed and wounded, he took position on the right of Rosecrans' army, with his left, Sheridan's division, on the Wilkinson pike and with Davis's division on the right of Sheridan. At first R. W. Johnson's division was in reserve, but when McCook ascertained that the Confederate left overlapped him, Johnson was brought up on the right of Davis. Thomas rested his right, Negley's division, on the Wilkinson pike, connecting with Sheridan. Crittenden's left rested on Stone River, with his right across the Nashville and Murfreesboro pike connecting with Thomas.

General Wheeler had promptly informed General Bragg on the morning of the 26th that Rosecrans was on the march, upon which General Hardee's corps was ordered in from Triune, and Wheeler was directed to protect its flank, impede the Union advance and, when hard pressed, fall back upon the main body of the Confederate army, which was to give battle in front of Murfreesboro. Hardee's corps, consisting of the divisions of Breckinridge and Cleburne, with John K. Jackson's brigade as a reserve, made up Bragg's right wing; its right rested on the Lebanon pike, north of Murfreesboro, its left on the Nashville road. Wheeler's cavalry was on the right. Polk's corps — the divisions of Withers and Cheatham — was on Hardee's left, connecting with it on Stone River; McCown's division of E. Kirby Smith's corps, which at first was held in reserve east of the river, was ordered on the night of the 29th to cross over and extend Polk's left; so, on the night of the 30th, Hardee's corps was east of Stone River and Polk's corps and McCown's division west of it. The two armies bivouacked opposite each other; west of the river they were not over 500 yards apart. Rosecrans had on his rolls 56,000 men, of whom 43,400 were to become engaged; Bragg 51,000, of whom 37,700 were to be carried into action.

While Rosecrans was taking position on the 30th Wheeler's cavalry was raiding his rear. Wheeler, with seven regiments of cavalry and a part of a battery, started from Bragg's right, on the Lebanon pike, about midnight of the 29th, crossed Stone River at Jefferson, after daylight, and attacked Starkweather's brigade, by which, after a sharp fight, he was repulsed, with a loss to Starkweather of 122 men, most of them prisoners, but he captured and burned part of the brigade train. He then marched for La Vergne, picking up stragglers and burning wagons, and reaching La Vergne at noon of the 30th, attacked and captured the immense supply-train of McCook's command, which he burned, took and paroled over 700 prisoners and, pushing on to Rock Spring, attacked, captured and destroyed another large train. He then marched to Nolensville, capturing large trains, stores and arms, and about 300 prisoners, who were paroled; halted near Nolensville for a short rest; and at 2 A.M. of the 31st resumed his march and joined the left of the army, then engaged. He had made a complete circuit of the rear of Rosecrans' army, had taken and paroled over 1,000 prisoners, and destroyed over $1,000,000 worth of stores, leaving miles of road strewn with burning wagons. He brought back with him nearly 5,000 stand of small arms.

According to Rosecrans' plan of battle, McCook was to hold fast on the right and keep back Bragg's left in his front, while Thomas and the right division of Crittenden were to open the battle on the morning of the 31st with skirmishing, and to engage Bragg's centre and left as far as the river, and Van Cleve's and Wood's divisions of Crittenden's wing were to cross Stone River and attack Bragg's right, to drive it back through Murfreesboro, and into the open country toward Salem. Thomas was to take up the movement on Crittenden's right. The attack was to commence at 7 A.M.; Van Cleve's and Wood's divisions had been massed on the left; Van Cleve's skirmishers had crossed the stream, and one of his brigades had followed and formed line and the rest were in motion, when the roar of battle came up from the right, the movement on Bragg's right was abandoned, Van Cleve was recalled, and Rosecrans was obliged to yield his plan of battle to one laid down by Bragg.

Bragg had determined to attack and turn Rosecrans' right at daybreak, and for that purpose, leaving Breckinridge's division to hold the right against Rosecrans' left, Hardee was ordered to march Cleburne's division from the right to the left, take command of that and of McCown's division, and open the fight at daybreak by an attack upon McCook's right. Hardee's attack was to be followed up by Polk's divisions in succession to the right, the move to be made by a constant wheel to the right on Polk's flank on the river, as a pivot, the object being to force Rosecrans back on Stone River, gain the roads in his rear, and cut him off from his base of operations and supplies by the Nashville pike. On the night of the 30th Hardee led Cleburne's division to the left and placed it in rear of McCown. At daybreak McCown advanced and fell upon the right of R. W. Johnson's division while the men were preparing breakfast. The skirmishers had seen the advance and had resolutely opposed it, while the main line was preparing to meet the shock. The skirmish-line was driven in by the impetuous Confederate advance, and McCown, swinging to the right, overlapped Johnson's right, soon overcame the two brigades holding the first line, captured most of their artillery, and swept them from the field. McCown's first movement had diverged somewhat to the left, leaving an opening between his right and the left of Withers' division, into which Cleburne's division sprang, and then advanced on Davis' division, and it was severely engaged with Davis when Johnson gave way, upon which McCown turned one of his brigades upon Davis' flank. Davis changed front on his right, to meet McCown, made counter attacks upon Cleburne in his front, and repulsed some of Cleburne's fierce assaults, but was finally forced back with great loss, with a part of Sheridan's division on his left. Sheridan also changed front to meet attacks upon his flank; but after desperate fighting, making three successive stands and repulsing some furious assaults, he was obliged to fall back upon the divisions of Negley and Rousseau of Thomas' command, on the left of the Wilkinson pike; and upon those and Sheridan, Polk's two divisions of Withers and Cheatham fell with great force, attacking them in front, left flank, and rear, causing them to fall back in rear of Crittenden's line. The entire right and centre of the Union line had now been driven back beyond the Wilkinson pike, and Rosecrans made heroic efforts to stem the tide setting against him and hold the Nashville pike, his only remaining connection with Nashville, and on which were all his trains. Everything was rallied on a new line covering this road, and Van Cleve's division of Crittenden's wing was brought up. There was another fierce struggle, but the Confederate attack was repulsed, with Rosecrans' right and centre thrown back at a right angle to its position of the morning, and with Bragg's line also at a right angle to his original line, the left of Rosecrans and the right of Bragg resting on Stone River. It was now past noon; Bragg held a large part of the field, with many prisoners, guns, wagons and ammunition, and the dead and wounded of both armies; but Rosecrans still held the road to Nashville. Bragg had made persistent efforts to crush the left of the Union line, where it rested near Stone River, and Polk's corps had been bloodily repulsed in several assaults on that part of the Union line. Another effort was now made. At 10 A.M. Bragg had ordered Breckinridge to send one brigade and, soon after, a second to reinforce Hardee; but when Bragg was informed that Rosecrans' left was crossing the river to attack Breckinridge the order was countermanded. It was ascertained that the information of an attack upon Breckinridge was incorrect; upon which Bragg ordered Breckinridge to send two brigades to report to Hardee, and soon after gave him a second order — to leave one brigade east of Stone River and march with the rest of his command to Hardee's support. When the brigades of Adams and Jackson crossed Stone River Hardee had been checked and thrown back, and the two brigades were sent to Polk, who was still assailing Rosecrans' left. The two brigades, the right of their line resting on Stone River, went forward, relieved part of Cheatham's, and became hotly engaged, but were driven back with great slaughter, some regiments losing more than half their men. As they were falling back Breckinridge came up with the brigades of Preston and Palmer, which were sent forward and speedily repulsed. Cannonading continued until nightfall, when, exhausted by a conflict of full 10 hours' duration, rarely surpassed for its continued intensity and the heavy losses sustained, both armies sank to rest.

While Bragg's infantry and artillery were breaking the Union lines and forcing them back, his cavalry under General Wharton, with part of McCown's infantry were engaged on Rosecrans' right and rear, inflicting losses in killed and wounded, capturing guns and wagons, and taking nearly 2,000 prisoners.

Rosecrans' losses during the day had been appalling, and when night came he was in some doubt whether to remain on the field. He says: "After a careful examination and free consultation with corps commanders, followed by a personal examination of the ground in rear as far as Overall's Creek, it was determined to await the enemy's attack in that position, to send for the provision train and order up fresh supplies of ammunition, on the arrival of which, should the enemy not attack, offensive operations were to be resumed." There was a readjustment of the line, the left was drawn back, though still resting on Stone River, and the right and centre grasped more firmly the Nashville road. On the morning of 1 Jan. 1863 Bragg began to demonstrate with infantry and artillery, and again Wheeler's and Wharton's two brigades of cavalry sought the rear of the Union line. They attacked a large train near La Vergne, capturing part of it and a piece of artillery, and informed Bragg that heavy trains were moving toward Nashville, some loaded, and all the ambulances filled with wounded. Early in the morning Van Cleve's division, commanded by Col. S. Beatty, supported by Grose's brigade, was thrown across the river from the left, and formed line on a hill in front of Breckinridge, who had resumed his position on that side, on Bragg's right. During the morning of the 2d there was quiet along the lines except on Rosecrans' left, where there was some shelling, but there were indications that Bragg was meditating an attack upon Rosecrans' left, and preparations were made to meet it, Davis' division being ordered from the right to the left and some changes made on that flank. From his headquarters west of the river Bragg had seen that Polk's line could be enfiladed by artillery placed on the hill occupied by the right of Van Cleve's division, and after noon Breckinridge was ordered to take the hill and occupy it with his artillery. The two brigades that yet remained west of Stone River were returned to Breckinridge, and he was reinforced by 2,000 of Wharton's and Pegram's cavalry and some artillery. Breckinridge formed his division in two lines, two brigades in each, with two batteries of artillery in rear. He had, excluding the cavalry, which came too late to take an active part, about 4,500 men. The distance to be traversed was about 1,600 yards. At 4 P.M. the signal-gun was fired, and the four brigades advanced to the attack. After a severe fight the two right brigades of Van Cleve's division were broken and driven from the hill and toward the river. Bragg's order had been fully obeyed, but the Confederates, exultant with success, did not stop at the hill, but pursued the broken Union fragments, and as they neared the river a few of them crossed it. Major John Mendenhall, who had hurriedly massed 58 guns on a commanding position on the west bank of the river, opened fire with all the guns upon the somewhat massed column, the infantry added their fire, and Breckinridge's attack was repulsed. That part of Van Cleve's line that had not been driven across the river attacked the fleeing Confederates, a Union brigade, without orders, crossed the river in pursuit, and the Confederates were driven back to the position from which they had advanced with a loss of four guns and over 1,700 killed and wounded of the 4,500 engaged. It was night, and Davis' and Wood's divisions were sent across and intrenched on the hill that had been the point of contention. A cold and heavy rain-storm marked the 3d, and, fearing a rapid rise in the river, Rosecrans withdrew all his troops from the eastern side of it. No other movement was made on the lines, the day passed in comparative quiet, and at night Bragg, under the erroneous impression that Rosecrans was receiving reinforcements, marched for Tullahoma, 36 miles distant. The 4th was occupied by Rosecrans in burying the dead, and on the 5th his army occupied Murfreesboro. The Union loss in the battle, including 53 killed and 259 wounded in minor engagements between Nashville and Stone River, was 1,730 killed, 7,802 wounded and 3,717 missing, an aggregate of 13,249. The Confederate loss was 1,294 killed, 7,945 wounded and about 2,200 missing. Consult 'Official Records' (Vol. XX); Van Horne, 'History of the Army of the Cumberland' (Vol. I, Cincinnati 1875); Stevenson, A. F., 'Battle of Stone River' (Boston 1884); The Century Company's 'Battles and Leaders of the Civil War' (Vol. III, New York 1887–88).

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STONE WORSHIP, a form of fetishism which has persisted in the religions of some cultivated races. The ancient Germans and Gauls paid reverence to stones: Saint Eligius (Eloi), bishop of Noyon, exhorts his Frisian converts against this practice: "Let no Christian presume to set lights or to say prayers (*reddere vota*) at fanes or rocks or fountains or trees:" and throughout the Middle Ages the Church never ceased to condemn the practice of addressing prayers or vows to stones — *votum vovere ad lapidem vel ad quamlibetrem*. All the great nations of antiquity worshipped stones: at Pharæ in Achaia, according to Pausanias, 30 square stones were worshipped; and he adds that in earliest times "rude stones, instead of images, received divine honors." Meteorites have ever been special objects of worship: such was the stone symbol of Diana at Ephesus, of the sun-god at Emesa in Syria, of Mars at Rome; such too was the Kaaba at Mecca. As stones are in India set up standing in groups as representing deities, Tylor conjectures that menhirs, cromlechs and dolmens may have had a like signification.

STONECHAT, a small and pretty European non-migratory bird (*Motacilla rubicola*), closely related to the American bluebird and the familiar English wheat ear. It is chiefly terrestrial in its habits.

STONEHAM, stōn'ạm, Mass., town in Middlesex County, on the Boston and Maine Railroad, 11 miles north of Boston. It was incorporated and became independent of the adjoining towns in 1725. It has several large manufacturing establishments, among which are boot and shoe factories, machine shops, box factory, tanneries and a furniture factory. It has a number of fine residences, six churches, 23 elementary school buildings, a high school and a public library. There are a national and a savings bank. Pop. about 7,090, of which 6,300 are in the borough proper.

STONEHENGE, stōn'hĕnj, a notable example of the ancient stone circles, situated in Salisbury Plain, Wiltshire, England, about seven miles north of Salisbury and within two miles of the town of Amesbury. The structure consists of two concentric circles of upright stones surrounding two concentric ellipses; the whole surrounded by a double earth wall and ditch, about 370 yards in circumference. There is an entrance at the northeast which proceeds in the form of an avenue, guarded on each side by a wall and a ditch, for a distance of 594 yards, after which it divides, one branch going eastward up a hill, between two groups of burial mounds or barrows, and the other branch leading northwest to the cursus or race-course, about 300 yards distant. The outer earth-wall is 15 feet high, the ditch 30 feet wide and the avenue at the entrance 15 feet wide. The outer circle is about 105 feet in diameter and consisted when complete of 60 stones, 30 uprights and 30 horizontal imposts between them. The upright stones are about 16 feet high and six or seven feet thick. Of the original 60 there remain 32 stones, being 17 uprights in position, seven prostrate and eight imposts. At the avenue entrance there are 11 uprights remaining with five imposts. The uprights of the outer circle were placed about four feet apart, with the imposts fitted to them continuously at their top, each upright bearing a vertical peg at each side, into which fitted a mortise in the end of the horizontal impost. The imposts are on an average about 10 feet long, three and one-half feet wide and two feet eight inches deep. There is a space between the outer and the inner circles of from eight to nine feet forming a walk 300 feet in circumference. The number of uprights composing the inner circle has been stated variously, the different figures ranging from 40 to 60; there were no imposts in the inner circle and the height of the stones, judging from the 11 still standing, seems to have been about six feet. This circle, like the first, has an opening to the northeast, opposite the entrance. But unlike the outer circle, it is composed, not of hewn sandstone, but of smaller rocks, seemingly boulders brought from a distance. Within the inner circle and about the same distance from it as the outer circle stands the first oval, an incomplete oval, in the shape of a huge horse-shoe with its open end facing the entrance at the northeast. The first oval consists of five groups or trilithons, each trilithon being composed of two uprights with an impost at the top completely covering their upper edges. The five trilithons are thus independent and not connected by continuous imposts. Their size gradually rises from east to west, the largest being the grand central trilithon in the closed end of the ellipse and the smallest, about 16 feet high, those nearest the entrance. The height of the central trilithon, with impost, is 28 feet, the pillar stones being about 23 feet above ground, and the impost about four feet thick. Other dimensions of this trilithon are: Length of impost, 15 feet; breadth, four and one-half feet; breadth of uprights, seven and one-half feet; thickness, four feet. The other four trilithons stood two and two facing each other. Only two of these five groups are now perfect. One of the pillars of the central trilithon, fallen, is broken into three pieces; the impost though fallen is intact, and the remaining upright is nine feet out of the perpendicular. Of the two trilithons of the west side the one nearer the centre fell outward, entire, in 1797; though prostrate the stones are intact. The other trilithon on the west broke up at an earlier date; one of its pillar stones remains standing — the other and the impost lie at its foot, broken. The trilithons of this, the outer ellipse, are of hewn sandstone like the stones in the exterior circle. Within this outer ellipse is a smaller one of the same shape, with the opening facing the northeast, but, like the inner circle, composed not of tool-dressed sandstone, but of bluestone boulders, and, also like the inner circle, without imposts. The stones employed in the smaller ellipse are on an average about a foot to a foot and a half taller than those in the smaller circle; they are set at intervals of about five to six feet. Within the inner oval, at its upper end, in front of the central trilithon, is a slab of coarse-blue marble, 16 feet long, four feet broad and 20 inches thick. This is commonly spoken of as the altar stone. The cursus at the end of the western branch of the avenue of approach is a stretch of flat land, about one and three-fourths miles long and 110 yards across. It is bounded by parallel banks and ditches and is rectangular in shape, with a flat mound stretching across its eastern end. There is a smaller cursus a little to the north and barrows lie all around. Within the avenue of approach there is a large upright which has been nicknamed the Friar's Heel. It is 16 feet high and is supposed to be a bowing-stone.

The purpose of Stonehenge, its time of erection and the race or races which built it, will probably never be known with certainty. Despite the efforts of the numerous archæologists who have given it their attention, nothing in the nature of proof has been found for anyone of the various theories. It is generally accepted as an extraordinary development of the stone circles (q.v.) found throughout Great Britain and in parts of France and Scandinavia. For a long time these circles were known as Druidical Rings, and Stonehenge was regarded as probably the head temple of Druidical worship. This theory, however, has been discredited recently on account of the discovery that many other of these monuments, also supposed to be of Druidical origin, were of a sepulchral nature. The circular form of the monument has suggested to some writers that it was connected with a worship of the sun. By others it has been attributed to the Phœnicians, the Belgæ, the Saxons and the Danes. It has been called a martial court of justice — a battle ring for judicial combatants — a shrine to Buddha, a temple to serpent worship and a monument of victory. The theory most widely accepted is that it is a burial ground or a temple connected with burial ceremonies for some ancient people who inhabited at some time the greater part of Great Britain and who either emigrated from or to the shores of France and Scandinavia. The fact that Stonehenge is the centre of a region numerous in barrows, and that this is true of all the other great stone circles or standing stones seems to bear out the likelihood of its connection with the burial ceremony. Sir John Lubbock assigns its date as that of the Bronze Age, basing his beliefs on the character of the contents found in the surrounding barrows and upon the evidences of tool-work upon the stones of the outer circle and outer ellipse. This latter fact, however, is interpreted by others merely as an indication that the other portions of the structure are of much older date.

Stonehenge is first mentioned in the 9th century by Hennius, who states that it was erected in the 5th century by Ambrosius, the last Briton king, aided by the magician Merlin, to commemorate the 460 Briton nobles who were treacherously murdered at that spot by Hengist, the Saxon. This legend is repeated by Henry of Monmouth in his 'Historia Britonum,' in the 12th century, and then by numbers of the historians of the Middle Ages. The first history of Stonehenge, written by Inigo Jones, and published in 1655, speaks of the structure as a Roman temple and deprecates its demolition by the country-folk of the neighborhood, who removed portions of the fallen stones to build bridges, make mill-stones and for such like uses. (See STONE CIRCLES). Consult Barclay, 'Stonehenge and Its Earthworks' (1895); Davies, 'Celtic Researches' (1804) and 'Mythology of the Druids' (1809); Gidley, 'Stonehenge Viewed in the Light of Ancient History,' etc. (1877); Sir Henry James, 'Plans and Photographs of Stonehenge' (1867); Lockyer, 'Stonehenge and Other British Stone Monuments Astronomically Considered' (1906); Long, 'Stonehenge and its Barrows' (1876); Sir John Lubbock, 'Prehistoric Times' (ed. 1898); Flinders, Petrie, 'Stonehenge' (1881); and Stukeley, William, 'Stonehenge and Abury' (1840).

STONEMAN, stōn'man, **George**, American soldier: b. Busti, N. Y., 8 Aug. 1822; d. Buffalo, N. Y., 5 Sept. 1894. He was graduated at West Point in 1846, served on the Pacific Coast (1847–57), in 1855 was promoted captain, and until 1861 was on duty mainly in Texas. Early in 1861, while in command of Fort Brown in that State, he was ordered by General Twiggs to surrender to the Confederates. He refused, evacuated the fort, and with his men sailed by steamer to New York. In August 1861 he became brigadier-general of volunteers and chief of cavalry in the Army of the Potomac, and commanded the cavalry in the Peninsula Campaign of 1862 (q.v.), distinguishing himself at the battle of Williamsburg (q.v.). In November 1862 he was promoted major-general of volunteers, having already been placed in command of the Third corps, which he led at the battle of Fredericksburg. He led a cavalry raid toward Richmond during the Chancellorsville campaign. In April 1864 he took command of a cavalry corps in the Army of the Ohio, and during the Atlanta campaign made another notable raid (see STONEMAN'S MACON RAID). At Clinton, Ga., he was captured in July 1864, and for three months was kept a prisoner. In December 1864 he made his third important raid (see STONEMAN'S RAID FROM EAST TENNESSEE INTO SOUTHWESTERN VIRGINIA); and in the following March he entered upon still another of these remarkable incursions into Confederate territory. (See STONEMAN'S RAID IN EAST TENNESSEE, SOUTHWEST VIRGINIA AND WESTERN NORTH CAROLINA). In 1871, having received several brevets in the regular army, he retired from the service and settled in California, where for six years he served as a railroad commissioner, and from 1883 to 1887 was governor of the State, to which office he was elected by the Democratic party.

STONEMAN'S MACON RAID. When General Sherman was operating against Atlanta he ordered all his available cavalry to prepare for a blow at the Macon Railroad, simultaneously with the movement of the Army of the Tennessee toward East Point. General Stoneman, with 5,000 cavalry, was to move by the left around Atlanta to McDonough, and Gen. E. M. McCook with two divisions of 3,500 men, by the right on Fayetteville; and on the night of 28 July 1864 Stoneman and McCook were to meet on the Macon Railroad, near Lovejoy's Station, and destroy it in the most effectual manner. On the morning of the 27th both columns started. McCook on the right, with 3,200 men and eight guns, marched down the west bank of the Chattahoochee, laid a pontoon-bridge near Riverton and crossed, and moving on Palmetto Station, on the West Point Railroad, tore up some two miles of the track, and went on to Fayetteville, where he captured about 250 prisoners, 500 wagons, which he burned, and 800 mules, a greater part of these he killed, and then pushed on to the Macon Railroad at Lovejoy's Station, about seven miles below Jonesboro, and 30 from Atlanta. He hoped here to meet Stoneman, but heard nothing of him, destroyed the depot, the railroad to some extent, burned army trains, and was prosecuting his work in the destruction of the road, when he was driven off it by a considerable Confederate force, and still hearing nothing from Stoneman, endeavored to return and recross the Chattahoochee by marching southwest, and had reached Newman, on the West Point Railroad, on the 30th, where he encountered an infantry brigade, coming from the south and at the same time was attacked in rear by Jackson's division of Wheeler's cavalry, soon reinforced by Wheeler himself with two additional brigades. McCook had several hard encounters, in some of which he was successful, but was forced to let loose his prisoners, about 400 in number, abandon his artillery and trains, and cut his way out, each brigade commander looking out for himself, and succeeded, with parts of his command, in reaching the Chattahoochee, which he crossed and marched to Marietta, with a total loss of about 600 men. Stoneman at the moment of starting had received Sherman's permission after the completion of his work at Lovejoy's, to march on Macon and Andersonville and release the thousands of Union prisoners, at these places. Marching on the morning of the 27th, he left Gerrard's division at Flat Rock, and with the brigades of Colonels Adams, Biddle and Capron, in all about 2,200 men, crossed the Ocmulgee River, near Covington, and made for the railroad running from Macon to Augusta, on which he destroyed a large number of engines and cars at Gordon and Griswoldville. A detachment went eastward and burned the bridge over the Oconee. Stoneman reunited his detachments near Macon, on the 30th, but the river was between him and the city, and he contented himself with shelling the place and then moved back toward Clinton. Meanwhile he had heard that the prisoners had been removed. General Iverson's cavalry division had been ordered by Wheeler to follow Stoneman, and was now upon him. On the morning of the 31st Stoneman, finding what he supposed to be a heavy Confederate force in his front, deployed a strong line of skirmishers, which soon developed the fact that Allen's brigade of Confederate cavalry had passed around his flank and taken up a strong position directly across his line of retreat, while Armstrong's brigade, co-operating with Allen's, was closely menacing his left flank. Dismounting the men of one brigade he repeatedly charged the Confederates, but every charge was repulsed with heavy loss, and Armstrong followed by a charge upon his left flank. The Union line gave way and was with difficulty rallied and re-formed. By this time he was nearly surrounded, and as he mistakenly thought by a greatly superior force. Believing further resistance useless, he authorized his brigade commanders to cut their way out, while he, with a regiment and a section of artillery, held the enemy in check until the others got through, when he surrendered about 500 men. The greater part of Adams' brigade escaped and joined the army near Atlanta. Capron's brigade escaped, but was subsequently surprised and scattered, very few getting back to the Union lines. Consult 'Official Records,' (Vol. XXXVIII); Van Horne, 'History of the Army of the Cumberland,' (Vol. II, Cincinnati 1875); Sherman, W. T., 'Personal Memoirs' (Vol. II, New York 1875).

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STONEMAN'S RAID FROM EAST TENNESSEE INTO SOUTHWESTERN VIRGINIA. After the defeat of General Gillem's Union brigade at Russelville, Tenn, (q.v.), 14 Nov. 1864, General Thomas, commanding the Military Division of the Mississippi, of which East Tennessee was a part, ordered General Stoneman to concentrate his forces in Kentucky and advance from Lexington to Cumberland Gap to oppose General Breckinridge should he attempt to move into Kentucky, and to advance into East Tennessee and drive Breckinridge back into Virginia or North Carolina. Thomas' instructions were "to concentrate the largest possible force against Breckinridge, and either destroy his force or to drive it into Virginia and, if possible, destroy the salt-works at Saltville, and the railroad from the Tennessee line as far into Virginia as he could go without endangering his command." These instructions were repeated by Thomas on 6 December, when it was known that Breckinridge was on the retreat. By the 9th Stoneman had completed the organization of his command and was ready for operations in the field. He had a body of mounted troops, under General Burbridge, that had been doing duty in Kentucky, the Tennessee brigade of General Gillem, and some infantry and dismounted cavalry under General Ammen, in all a force of 8,000 men. The Fourth Tennessee and Third North Carolina (Union) regiments were sent to Paint Rock to hold the pass over the mountains into North Carolina, and Stoneman concentrated his command at Bean's Station on the 11th. Stoneman started from Bean's Station on the 12th, with Gillem's and Burbridge's commands of about 5,700 men, and Gillem, in advance, reached the north fork of the Holston River, opposite Kingston, during the night, crossed after a sharp engagement, and early in the morning of the 13th attacked and routed Duke's cavalry under Colonel Morgan, capturing Morgan and 80 of his men and his entire wagon train. During the day Burbridge pushed on to Bristol, to intercept General Vaughn, who had been holding Greenville with some 1,200 men. Stoneman, with Gillem, joined Burbridge at Bristol early on the 14th, and fearing that Vaughn would pass in the night and join Breckinridge at Saltville or in the vicinity, Burbridge was pushed on to Abingdon, with instructions to send the 12th Kentucky cavalry forward to strike the railroad between Saltville and Wytheville to prevent the former place from being reinforced by troops from Lynchburg. The 12th Kentucky, after threatening Saltville, struck the railroad and cut off two trains that had brought Breckinridge with a battery and reinforcements from Wytheville, accomplishing its object. Stoneman now decided to push on to Wytheville, destroy that place and the salt-works on New River, and attend to the capture of Saltville on his return. He moved early on the 16th and Gillem overtook Vaughn at Marion, attacked and routed him, pursuing to Wytheville, capturing his trains, artillery and 198 men, and destroying the town. About midnight Burbridge's command was put on the road, and reached Mount Airy at daylight of the 17th, where Colonel Buckley's brigade was detached to destroy the lead-mines 25 or 30 miles beyond, in Wythe County, which was accomplished without loss. Having destroyed the railroad and bridges some distance beyond Wytheville, Stoneman now set out on his return to destroy the salt-works at Saltville, and on the 17th encountered Breckinridge in a strong position at Marion. He had moved out of Saltville with all the troops he could collect that had been operating in East Tennessee, and had not far from 2,000 men. With these he had proposed to follow Stoneman and attack his rear. He now stood in the path of his return. Burbridge, who was in the advance with two brigades, engaged him and called upon Stoneman for reinforcements; and Stoneman, riding forward, took the command in his own hands. Night soon came on, the troops had become disarranged, and a general attack was delayed until morning, when it opened with great spirit, Stoneman meeting with a stiff resistance and some loss, and making no headway. Buckley was supposed to be coming up in the afternoon, and Gillem, now up, was sent around Breckinridge's left, thus cutting him off from the salt-works. The skirmishing during the day was accompanied with considerable loss on both sides, and as soon as night set in Breckinridge finding himself cut off from Saltville, and nearly surrounded, withdrew by the road leading over the mountains into North Carolina and escaped. The 12th Ohio cavalry was sent in pursuit, capturing some abandoned wagons and caissons, and then returned; and that night Stoneman concentrated his command at Glade Springs. At daybreak of the 20th Stoneman advanced on Saltville in two columns, Burbridge to enter the place on the north, Gillem on the south. Gillem arrived first and waited for Burbridge, who was not in position, and night coming on and nothing yet accomplished, Colonel Stacy, with the 13th Tennessee cavalry, was ordered to make a detour to the left and dash into the town. Stacy carried out his orders to the letter. He dashed into the town, set part of his regiment to work in burning it and with the remainder charged the fortifications, held by 400 men under Colonel Preston, went over them, dispersing Preston's men, and capturing two guns and a number of prisoners without the loss of a man. Stoneman says the charge "was a signal for a general stampede of the enemy, and by 11 o'clock in the night all the works were evacuated and in the possession of Colonel Stacy, and the town of Saltville was in flames." All day and night of the 21st was devoted to the destruction of the salt-works and all the machinery, and on the 22d Stoneman began his return march, Burbridge going by way of Big Sandy to Kentucky, and Gillem to Knoxville by Poor Valley and the west side of Holston River. Stoneman reports that he captured 34 officers and 845 men, 19 guns, 3,000 horses and mules, great quantities of ammunition, and from 50,000 to 100,000 bushels of salt, and that he destroyed the towns of Bristol, Abingdon, Wytheville and Saltville, 13 railroad trains, with engines attached, several trains without engines, all the depots of supplies in southwest Virginia, and railroad depots, foundries, mills, storehouses, turnpike and railroad bridges, but that the greatest loss inflicted was the destruction of the lead-works 17 miles from Wytheville and the salt-works at Saltville. A Confederate writer says: "The damage inflicted upon southwest Virginia by this Federal raid, in the destruction of railway and turnpike bridges, railway stations and warehouses, ironworks, woolen mills, leadworks and army supplies of all kinds was very injurious to the Confederacy, greatly crippling its defensive power in that region, and was also a serious blow to the Army of Northern Virginia by depriving it of supplies from that great storehouse of agricultural wealth." Consult 'Official Records' (Vol. XLV); Van Horne, 'History of the Army of the Cumberland' (Vol. II, Cincinnati 1875).

E. A. Carman.

STONEMAN'S RAID IN EAST TENNESSEE, SOUTHWEST VIRGINIA AND WESTERN NORTH CAROLINA. Early in February 1865, General Grant directed General Thomas to send an expedition under General Stoneman from East Tennessee to penetrate North Carolina and well down to Columbia, S. C., to destroy the enemy's railroads and military resources in that section and visit a portion of the State beyond the control or reach of Sherman's column, which had started on its march northward from Savannah. On the 27th Grant wrote that Stoneman was to repeat the raid of the previous fall, destroying the railroad as far toward Lynchburg as he could. As the movement was merely for the purpose of destruction, Stoneman was to avoid any heavy engagement. Stoneman's force, which was concentrated at Mossy Creek, East Tennessee, 22 March, consisted of the cavalry division of Gen. A. C. Gillem, three brigades of three regiments each, under Cols. W. J. Palmer, S. B. Brown and I. K. Miller, numbering about 6,000 men. It had now become known that Sherman had captured Columbia, S. C., and there were rumors that Lee's army would evacuate Petersburg and Richmond, with the possible intention of moving by way of Lynchburg to Knoxville; and Stoneman was, therefore, directed to move toward Lynchburg, give his first attention to the destruction of the railroad, and then sweep through western North Carolina. On the 24th Stoneman moved to Morristown, and sent Miller's brigade to cut off a Confederate force between Jonesboro and Carter's Station, but the force escaped, and on the 26th Miller rejoined Stoneman, who had advanced to Jonesboro. All encumbrances were thrown aside, and with but four guns, and two ambulances to accompany the column, Stoneman left Jonesboro on the 26th and, crossing Iron Mountain, arrived at Boone, N. C., on the 28th, where he captured a body of home-guards, and the column was divided marching by two different routes across the Blue Ridge and through Wilkesboro, Jacksonville and Mount Airy, N. C., and Hillsville, Wytheville, Christianburg and Salem, Va., to within four miles of Lynchburg, destroying bridges and railroad track, capturing trains and prisoners, and causing the Confederates to abandon many guns. This was accomplished by 6 April, at which time Stoneman had possession of 90 miles of the Virginia Central Railroad, from Wytheville nearly to Lynchburg. The bridges over Roanoke and New rivers were destroyed, and on the 9th the entire command arrived at Danbury, N. C. Next day at Germantown, beyond Danbury, Palmer was detached and ordered to Salem, N. C., where he destroyed the extensive factories which were supplying the Confederate armies with clothing, then destroyed the railroad south of Greensboro, and also a part of it between that place and Danville, Va. The main column moved toward Salisbury, dispersing small bodies of the enemy, and bivouacking on the night of the 11th 12 miles north of that place. At midnight the march was resumed, and the South Yadkin River crossed, and at daybreak the Confederate pickets were driven in and across Grant's Creek two miles from Salisbury. The bridge across the creek was defended by 18 guns, under command of Col. J. C. Pemberton (formerly a lieutenant-general) and about 3,000 men, commanded by General Gardener. The flooring of the bridge had been taken up. Detachments were sent up and down the stream to cross and come in on the Confederate rear; and time being given for this, a charge was made on the bridge, the men went over on the stringers, and the Confederates were totally routed and pursued through Salisbury, Stoneman capturing the 18 guns, 1,364 prisoners, 10,000 stand of arms, and some wagons. At Salisbury an immense amount of public property was destroyed, and the railroad was wrecked for several miles south of the place. Having raided over 500 miles, destroying railroads, and capturing horses enough to refit his entire command, Stoneman concluded to take the prisoners and the captured artillery not destroyed to East Tennessee. He withdrew from Salisbury, on the 13th, and reached Lenoir on the 15th, where he turned over the command to General Gillem and, with a strong escort, conducted the artillery and prisoners to Tennessee. His instructions to Gillem were to scout on the east side of the Blue Ridge; to put Palmer's brigade at Lincolnton to scout down the Catawba; Brown at Morgantown, to connect with Palmer on the Catawba; and Miller at Asheville, to open communication through to Greenville, Tenn. When Gillem, with the two brigades of Brown and Miller, reached the Catawba, two and one-half miles from Morgantown, the bridge was found to be torn up, the ford blockaded, and the passage of the river disputed by General McCown with about 300 men and one gun. A flanking force was sent up the stream about two miles, crossed, and gained McCown's rear; the force in front attacked with artillery; and the infantry, crossing on the sleepers of the bridge, charged McCown and routed him, killing some of his men, and capturing his gun and about 50 prisoners. On the 19th Gillem moved toward Asheville, by way of Swannanoa Gap, reaching the gap on the 20th, which was found to be blockaded and defended by about 500 men with four guns. Leaving Miller to feint in front, Gillem, with the rest of his force, on the 21st, moved to Rutherford, 40 miles south of Swannanoa Gap, and at sundown on the 22d had passed the Blue Ridge at Howard's Gap, with but slight resistance and was in the enemy's rear. At daylight of the 23d his advance entered Hendersonville, where it was learned that the Confederates had retreated through the place. Pursuit was given and 70 men and four guns captured. The entire column then moved on Ashville, and at 3 P.M., when near the town, was met by a flag of truce, with a communication from General Martin, stating that he had received official notice of a truce between Generals Sherman and J. E. Johnston, and proposing a meeting next morning. At 11 P.M. an order was received from Sherman directing the command to move to Durham Station or Hillsboro. Being convinced that Sherman had given the order in the belief that the division was at or near Salisbury, and as it would have required a march of about 200 miles to reach Durham Station, and was but 60 to his base at Greenville, Tenn., Gillem determined to march to the latter place, and so informed General Martin, when he met him next morning, of whom he requested rations to make the march, and thus relieve him of the necessity of subsisting on the country, already impoverished. Martin furnished the rations, and on the 25th Gillem set his brigades in motion for East Tennessee. The raid was one of the most successful and destructive of the war. Gillem and Stoneman report the capture of 25 guns taken in action, and 21 that the Confederates were forced to abandon in southwestern Virginia; about 6,000 prisoners, and 17 battle-flags. Consult 'Official Records' (Vol. XLIX); Van Horne, 'History of the Army of the Cumberland' (Vol. II, Cincinnati 1875).

E. A. CARMAN.

STONEMAN'S VIRGINIA RAID. When General Hooker initiated the campaign finally resulting in the battle of Chancellorsville (q.v.), he ordered General Stoneman, commanding the cavalry corps of the Army of the Potomac, about 10,000 men and four batteries, to move quietly and rapidly up the left bank of the Rappahannock, on 13 April 1863, cross the river above the Orange and Alexandria Railroad, disperse Gen. Fitzhugh Lee's cavalry brigade at Culpeper Court House, push on to Gordonsville, and from there strike the Fredericksburg and Richmond Railroad at Saxton's Junction, destroying it with all its bridges and telegraph lines, thus severing General Lee's communications with Richmond. He was also directed to harass Lee's retreating troops that Hooker expected to defeat near Fredericksburg. Heavy rains delayed both Hooker's plans and Stoneman's movement, and after Stoneman had crossed one brigade at Freeman's Ford the Rappahannock rose so rapidly and high that the brigade was recalled and crossed to the left bank of the river by swimming the horses. Stoneman now waited two weeks for Hooker's initiative and better weather. On 29 April, under modified orders to cross the river between Kelly's and Rappahannock Fords, and to send one column in the direction of Raccoon Ford and Louisa Court House, Stoneman again crossed the river, with the main body, at Kelly's Ford. General Averell, with three brigades and a battery, was to cross at Rappahannock Station, under instructions to push on through Culpeper Court House to Gordonsville and keep the enemy employed in that direction, while detachments from the main body were destroying the railroads north from Richmond. Stoneman had in all six brigades of cavalry, numbering about 8,000 men, with two batteries. Averell was dilatory in his movement, but soon ran against a regiment of Gen. W. H. F. Lee's brigade, driving it through Culpeper Court House and beyond the Rapidan, where on the morning of 2 May he received a message from Hooker that he did not understand what he was doing at Rapidan Station, and ordering him to rejoin the army at United States Ford. Averell immediately returned, and was relieved from command because he had failed to regard the instructions given him, and had contented himself with marching but 28 miles in three days with but an insignificant force opposing him.

With picked men and horses, in light marching order, not a wagon accompanying him, Stoneman pushed forward, with three brigades of 4,300 men and a battery of six guns; General Buford's regular brigade was sent to the left in detachments and, after skirmishing with small bodies of Confederate cavalry, reached the Rapidan at Raccoon Ford on the night of the 30th; Stoneman followed, the ford was crossed on the morning of 1 May, and at 2 o'clock on the morning of the 2d, after some opposition, and after marching through Orange Court House, Gregg's division of two brigades struck the Virginia Central Railroad about a mile from Louisa Court House and destroyed much of the railroad, and at daybreak Colonel Kilpatrick, with his regiment, dashed into Louisa Court House, captured some supplies, and toward evening being attacked by some of W. H. F. Lee's cavalry, withdrew to Thompson's Cross-Roads, and joined his division, which during the day had marched by way of Yanceyville, and concentrated at the Cross-roads after night. Here during the night Stoneman gave orders for operations upon Lee's communications by separate parties led respectively by General D. McM. Gregg, Col. P. Wyndham, Colonel Kilpatrick, and Lieut.-Col. Hasbrouck Davis. At midnight, with a bright moon, the various detachments started, and all were on the road before 3 A.M. of the 3d.

Wyndham, with two regiments of about 400 men, pushed southward to Columbia on James River, at its junction with the Rivanna, driving before him a squadron of cavalry, and on the morning of the 3d he destroyed some canal-boats, bridges, and a large quantity of supplies and medical stores, and attempted to destroy the stone aqueduct, by which the water of the canal was carried over the Rivanna; but hearing of the approach of W. H. F. Lee, he withdrew and rejoined Stoneman the same day, having marched 50 miles in 16 hours. He brought in 140 horses and mules, and was followed by Lee nearly to camp.

Kilpatrick marched, with one regiment, reached Hungary Station, on the Fredericksburg Railroad, at daylight of the 4th; destroyed the depot and part of the road, crossed to the Brook road, and went within two miles of Richmond, driving back a battery and some cavalry, and capturing about a dozen men within the fortifications of the city. Then he struck the railroad at Meadow bridge, over the Chickahominy, burned the bridge, ran a train of cars into the river, captured more prisoners and 60 wagons, crossed the Pamunkey and Mattapony next day, swept through the country without opposition, though closely pursued by cavalry, and reached Gloucester Point on York River on the morning of the 7th, with a loss of 38 men. He reported that he captured and paroled over 300 men.

Lieutenant-Colonel Davis, with one regiment, moved along the banks of the South Anna to the Fredericksburg Railroad at Ashland, scattered a few cavalry bodies, captured an ambulance train with about 250 wounded from the field of Chancellorsville, whom he paroled, destroyed the road and other property in the vicinity, and pushed on to Hanover Station on the Virginia Central Railroad, burned the depot and other property, marched to Hanover Court House, and then to within seven miles of Richmond, when he changed direction to the left and started down the Peninsula for Williamsburg. At Tunstall's Station, near White House, he met and had an engagement with Confederate cavalry, infantry and artillery and, being repulsed in an attempt to break through, withdrew, moved to the left, crossed the Pamunkey and Mattapony, and reached Gloucester Point, after a march of over 200 miles, with a loss of 35 officers and men.

Gregg and Buford meanwhile had been raiding in the neighborhood of the South Anna, closely watched by Wade Hampton and W. H. F. Lee. Buford's brigade was broken into detachments, and on the 4th one of these, under command of Capt. James E. Harrison, Fifth United States cavalry, was attacked at Flemming's Cross-Roads, by 800 men, under command of W. H. F. Lee. Harrison had less than 100 men, and after a hand-to-hand fight of about five minutes he retreated to Yanceyville with a loss of five killed and wounded, and two officers and 31 men captured. Lee fell back to Gordonsville, hearing by telegraph from Richmond that the enemy were everywhere. The whole of Stoneman's command, excepting the forces under Kilpatrick and Davis, was concentrated on the 5th at Yanceysville, on the South Anna. Stoneman says: «The six days having now expired, during which we were assured by the commanding general he would certainly communicate with us, and no communication having been received, no retreating enemy having been seen nor heard of, and no information as to the condition of things in the vicinity of Fredericksburg, except vague rumors of our defeat and capture, having been attained; supplies for man and beast becoming scarce; having accomplished all that we were sent to perform, and having come to the conclusion that Colonels Kilpatrick and Davis, with their commands, had gone in the direction of Yorktown, I determined to make the best of our way back to the Army of the Potomac.»

Knowing that the cavalry brigades of Lee and Wade Hampton were to the west of him, and that the withdrawal of Averell had exposed his flank and rear to an attack from them, he determined to send General Buford, with 650 men and picked horses, to threaten Gordonsville, and another force, under Captain Rodenbough, in the direction of Bowling Green, to threaten the enemy's communications and, under cover of night, with the main body, take the middle road through Tolersville, and crossing the North Anna near the Victoria Iron Works march to Orange Springs, where all were to rendezvous next day. Everything worked favorably. Buford marched to within two miles of Gordonsville, where he found infantry and artillery in position, awaiting his arrival, upon which he turned north, marched until nearly daylight, and halted on the north side of the North Anna, near Orange Springs, where at noon of the 6th he was joined by Stoneman, who had made a night march in a heavy storm. From Orange Springs Stoneman continued his march to Raccoon Ford, on the Rapidan, thence to Kelly's Ford, on the Rappahannock, which was crossed at daylight of the eighth by swimming the horses, and then to Bealeton.

The result of the raid was the capture of over 500 men and 460 horses and mules and the destruction of nearly 20 bridges and culverts, three trains of railroad cars, 122 wagons, several canal-boats, and a large amount of army supplies. The railroads had been cut in seven places, but these breaks, which General Lee considered as of small consequence, were soon repaired. As the chief object of the raid was the effectual destruction of Lee's communications with Richmond, which was not accomplished, it was considered a failure. The Union loss was five killed, 21 wounded and 163 missing. About 1,000 horses were broken down and abandoned, some being killed. There are no trustworthy records of Confederate losses in killed and wounded. Consult ‹Official Records,› (Vol. XXV); the Century Company's ‹Battles and Leaders of the Civil War› (Vol. III, New York 1887–88).

E. A. Carman.

STONES, STANDING, or STONE CIRCLES, are found in numbers throughout Great Britain, to a less extent in Norway and Sweden, and a few in France and northern India. The typical stone circle of Scotland, England and Ireland consists of rough, unhewed stone set up at comparatively equal distances in the form of a circle. These circles vary in size from a diameter of 20 feet to more than 100 feet, and are composed of stones of heights ranging from less than six feet to 19 feet, and of varying thicknesses. The stones are set up at distances of from five feet to six yards apart and the site of the circle is usually a level plain, although the gentle slope of a hill has sometimes been used. The stones used are often in the form of huge loaf-shaped boulders set up on end and wedged in with smaller rocks at their bases; sometimes the standing stones are set into a slight excavation in the soil. In a number of the stone circles found in Scotland the space between two of the upright pillars, usually the two at the southwest side of the circle, is filled by a large flat rock set up on edge and extending from pillar to pillar. The location of this distinguishing feature at the southwest seems coincident with the general plan of structure and location of the supposed altar stone in the structure of Stonehenge (q.v.). Some of the stone circles contain a second smaller circle within them, which circle is often composed of stones larger than those in the outside circle; and some of the examples show a ditch around the circle of pillar stones, or else an earth wall. In either case whether it is ditch or wall, the entrance over or through it is invariably to the northeast. The ditches are in some instances as wide as 30 feet with a depth of six feet; the walls rarely exceed five or six feet in height, and the entrances over the ditches are usually half as wide as the ditch proper. In one notable instance, that of a small circle of large stones near the Great Circle of Stennis, in Orkney, Scotland, both the ditch and the rampart occur, the latter within the former, and the entire interior area of the circle is raised about three feet higher than the surrounding level.

Besides the circles of standing stones and great boulders, there are also found in the same territory and in Algeria, Syria and northern Arabia, continuous circles of smaller stones bedded in the ground or resting on the surface. Explorations of the interior area of these circles has established the fact that they were used for burying grounds, and from the nature of the contents, the burial urns and the implements found beside the graves, Sir John Lubbock has concluded that they belong to the Bronze Age. (See STONEHENGE). But it is to the circles of standing stones that the chief interest attaches; and while it has never been proven that these areas were intended for burying grounds, there seems to be sufficient reason for belief that they were connected with the burial rites of the people who erected them. This theory is borne out by the presence of burial mounds or barrows (known as cairns in Scotland and Ireland) in close proximity to all the larger circles. Indeed in some cases the cairns were surrounded by the circle of stones; as is seen in the great chambered cairn of New Grange in Ireland and in the smaller ones of Clava, near Inverness. Although it is more often the case, the contents of the cairns, particularly of the larger ones, do not always show interments of the Bronze Age. In this latter case there is no incinerary urn containing the deposits or over them, and the remains show that there has been no cremation. In like manner many of the stone circles, indeed the great majority of them, show no evidence of tool-work in their building, while the imposts of the outer circle and outer ellipse of Stonehenge give conclusive proof of it.

As a rule the cairns which covered the cremation interments of the Bronze Age are smaller than those of the preceding period, and the custom of placing the burnt bones in a cavity in the soil, covered only by an inverted urn of clay, dispensed with the cairn altogether, while it retained the circle of standing stones as a visible mark or fence of the grave ground. In about 20 instances in which there has been systematic excavation of stone circles in Scotland, the examination of the interior space has disclosed burials of the Bronze Age mostly after cremation but occasionally unburnt. The cremated remains were deposited with cinerary urns placed either in an inverted position over the burnt bones or upright and containing the burnt bones, at the bottom of a shallow pit excavated in the subsoil. These cinerary urns exhibit the forms and ornamentation characteristic of the age of bronze. Sometimes the burials have been placed in cists of unhewn slabs of stone, covered by small cairns of loose stones, underneath the surface level; at other times the burnt bones of many burials have been found placed in shallow cavities excavated in the soil of the interior area of the circle near the bases of the upright stones. It seems from these circumstances that the common variety of stone circles, as found in Scotland, are cemeteries of the Bronze Age, and while, on the one hand, the difference in the size of the circles of Avebury and Stennis and in the structure and size of Stonehenge may point to a difference in purpose and use, on the other hand, the great size of the circle surrounding the chambered cairn at New Grange and the objects uncovered by the repair excavations at Stonehenge in 1901, seem to show that a great circle also was associated with a sepulchre.

The largest of the Scotch stone circles is that of Stennis, in Orkney. It has a circumference of 340 feet, enclosing an area of two and one-half acres, and is surrounded by a ditch 30 feet wide. It originally consisted of about 60 pillars, set about 17 feet apart, of an average height of about 13 feet. Of these 13 still stand and 10, though prostrate, are intact. The largest stone circle in England is that of Avebury, in Wiltshire, which consisted of a large outer circle of probably 1,000 stones of from 15 to 17 feet in height and 40 feet in circumference; this circle was about 1,000 feet in diameter and contained two smaller circles of 350 and 325 feet in diameter respectively. The inner circles each consisted of a double row of stones, a stone pillar 20 feet high occupied the centre of one, and a bowing-stone, or cromlech, that of the other. Surrounding the whole were a broad ditch and a high earth-wall, traversed by an avenue of approach which led toward the southeast for over 1,400 yards. This structure and Stonehenge are considered the most remarkable examples found in England of monuments of megalithic stones. In Norway and Sweden the few stone circles systematically explored have been found to be burial places of the Iron Age. They are usually simple circles composed of 8 to 13 stones; occasionally there are two concentric circles, one within the other, the inner circle being sometimes composed of small stones set close together in a ring. Sometimes there is a single pillar stone in the centre of the circle. As a rule they are not remarkable either for the size of the circles themselves or for the massiveness of the stones of which they are composed. Circles of standing stones are rare to the south of the Baltic. See bibliography under STONEHENGE. Consult also Dawkins, 'Early Man in Britain' (1880).

STONES OF VENICE. This work by John Ruskin, the first volume of which appeared in 1851 and the second in 1853, was the result of close study and labor in Italy and at home. It was a continuation and expansion of the theories he had already advocated in 'The Seven Lamps of Architecture' published in 1849. In that work he had sought to do for architecture what he had already achieved for painting in his 'Modern Painters' (q.v.) — to instil the sense of the indissoluble association of art with all other branches of human activity. The 'Stones of Venice' appeared contemporaneously with the 'Construction of Sheepfolds,' an eloquent plea for the reunion of Christian churches, and was as Carlyle wrote of it to the author, "a new Renaissance — a singular sign of the times — a sermon in stones." The book was beautifully illustrated with engraving from drawings by the author and some of the most prominent living artists and visualized an embodiment of the concrete idea which he sought to express, that the buildings and art of a people are the expression of their religion, their morality, their national aspirations and social habits.

STONEWARE is that kind of earthen ware (see CERAMICS) which is impervious to water and non-absorbent, almost non-porous, the whole substance of the paste being very silicious, either from the original nature of the clay or from a mixture with the clay of some natural silex such as flint. A simple test is that a broken fragment, if put to the tongue, will not seem to cling to its surface; whereas a broken flowerpot will cling tenaciously, this being caused by the rapid absorption of moisture by the porous substance. It is for this reason that stoneware is used for acid containers, bottles, vinegar jugs and all such common purposes, and also for larger and more decorative vessels in countries and in times where it is customary to use earthenware vessels instead of glass or metal at least to a great extent. Thus in the Rhine towns and northwestern Germany during the 14th and following centuries a very elaborate series of cans, jugs and flagons of all sizes from a pint to three or four gallons, were made and decorated by simple impressions from metal or wooden dies impressed upon the surface before firing; the pattern being afterward more or less emphasized by a thin glazing of blue applied in parts. The glaze of stoneware in the usual sense is no more a separate substance than that of Greek vases; it is a mere modifying of the surface generally by some vaporized ingredient which is absorbed during the actual process of firing. Thus the most common glaze, called salt-glaze, is generally understood to be produced by throwing into the furnace rough salt, which is vaporized and leaves the soda in its composition on the surface of the stoneware in the form of a slight, glassy film. The stoneware would not need this to be sufficiently resistant against water, wine or the like, but some acids would attack the stoneware, against which the glaze is a sufficient protection.

These decorative wares have been known to the collectors, and in museums and in treatises on Ceramics under the general name of grés de Flandre, as if they were of Flemish make, but this term is now replaced by such terms as Cologne Ware, German Stoneware and the like. In modern times stoneware has not been generally used for decorative purposes; but recent experiments in the national manufactory of porcelain at Sèvres in France have led to the invention or adoption of many brilliant colored enamels which can be applied to stoneware without in the least diminishing its value as a durable and weatherproof material; and in this way a whole class of architectural ceramic wares has been made practicable. Magnificent specimens of these wares — even to the extent of huge friezes containing many figures, were on exhibition at Paris in 1900 and any future attempts at decorative architecture will have to include the consideration of these new means of brilliant adornment in color and in form. See POTTERY.

STONINGTON, stŏ'nĭng-tŏn, Conn., town, New London County, on Long Island Sound and on the New York, New Haven and Hartford Railroad, about 10 miles east of New London and 40 miles southwest of Providence, R. I. It comprises the borough of Stonington and the villages of Mystic, Old Mystic and Pawcatuck. There is a good harbor. The principal industries are agriculture and the manufacture of machinery, printing presses, woolen goods, velvet goods, thread, fertilizers, cotton and silk goods, etc. The first permanent settlement in Stonington was made by William Chesebrough of Plymouth in 1649. In 1658 it was chartered by Massachusetts as Southertown; passed to Connecticut in 1662, and in 1665 was named Mystic, and Stonington the year following. It was attacked by Sir James Wallace in the frigate *Rose* in 1775 and in 1814 was bombarded four days by Admiral Hardy. Sealing and whaling were for many years among the town's most flourishing industries. The area of the town is 25,222 acres. It is reached by steamboat from Watch Hill in the summer season. Government is vested in a warden and burgesses as an official board. Pop. 9,477. Consult Palmer, 'Stonington by the Sea' (Stonington 1913) and Wheeler, 'History of the Town of Stonington from 1649–1900' (New London 1900).

STONY CREEK, Battle of, in the War of 1812. After the capture of Fort George (q.v.) General Dearborn sent Gens. William H. Winder (q.v.) and John Chandler with 1,300 troops in pursuit of the retreating British under Gen. John Vincent. Chandler marched to Stony Creek, within 10 miles of Vincent's position at Hamilton. Learning of the American advance, Vincent with 750 troops attacked on the morning of 6 June 1813 and might have captured the whole force of Americans had not the Indians accompanying him raised the usual war-whoop, thus warning the Americans of the attack. In the confusion that followed, both Chandler and Winder walked into the midst of the British troops and were captured, and Vincent, too, lost his way, being found the next day without sword or hat. The British loss was 23 killed, 134 prisoners and 55 missing; the Americans lost 17 killed, 38 wounded and 100 missing. Had the Americans pursued they might have captured the main body of the enemy, but abandoning baggage and leaving the dead unburied they retired 10 miles up Forty Mile Creek and thence went to Fort George arriving 8 June and remaining inactive until the battle of Beaver Dams (q.v.). Consult Armstrong, John, ‹Notices of the War of 1812› (Vol. I, pp. 134–141); ‹American State Papers, Military Affairs› (Vol. I, pp. 445–448); Brackenridge, H. M., ‹History of the Late War› (pp. 117–118); Brannan ‹Official Letters› (pp. 165–171); Lessing, ‹War of 1812› (pp. 602–604); Wiley and Rines, ‹The United States› (Vol. V, pp. 406–407).

STONY POINT, N. Y., town in Rockland County, on the west bank of the Hudson, and on the New Jersey and New York, the New York, Ohio and Western and the West Shore railroads, 35 miles north of New York City. At this point is the rocky promontory from which the town derives its name, which was strongly fortified during the Revolutionary War by the British. In 1779 the Americans had begun to fortify the place, but were forced to abandon it by the British under Clinton, who then completed the fortifications. The only land approach was across a marsh which was covered by water at high tide and was defended by a double line of abattis and picket stations. Washington had determined on a recapture of Stony Point and for this purpose organized a body of picked troops known as the Corps of Light Infantry and placed Gen. Anthony Wayne (popularly called «Mad Anthony») in command. Wayne carefully reconnoitered the place and decided for a night attack and surprise, which was carefully planned by Washington. In accordance with this plan, Wayne brought his men as near Stony Point as possible and by 8 P.M., 15 July, camped about a mile from the fort. Here he divided his force into columns, and about 11:30 commenced the march against the fort; when the marsh was reached, one column under Wayne turned to the south to cross the marsh, the other to the north. By the time the Americans had crossed the morass, the British were thoroughly aroused, and opened fire upon both columns. The Americans did not fire but charged with the bayonet so impetuously that the enemy were quickly driven from the outer abattis into the fort, where they were obliged to surrender; the two American columns reached the fort almost at the same time. Wayne was wounded in the head during the charge, and was carried into the fort but the wound proved slight. The whole British garrison of over 540 were taken prisoners; the Americans lost only 15 killed, the British 63. The Americans were not able to hold the place, but destroyed the fortifications, and it was reoccupied for a time by the British who, however, abandoned it in October. The immediate effect of the victory was to encourage the Continental army, and increase the confidence and zeal of the people. The site of the fortifications was acquired as a public park by New York State in 1897. The population of the village is less than 1,000, but the town's population is about 4,000. Consult Johnston, ‹The Storming of Stony Point› (New York 1900).

STONYHURST COLLEGE, England, a Roman Catholic institution 10 miles north of Blackburn, Lancashire. The college was originally founded at Saint Omer in Flanders in 1592, but in 1794 was transferred to England. It is affiliated to the University of London, and provides a school course of instruction for boys and a university course for young men. Attached to it is a good observatory, an excellent library of 40,000 volumes, museums, etc. Several wellknown men have been educated here. The series of ‹Stonyhurst Philosophical Manuals› by the Jesuit professors in the philosophical department of the college represents an able and notable attempt to revive the scholastic philosophy as expounded by Saint Thomas, and adapt it to modern thought.

STOOP, *in architecture*, an uncovered platform at the entrance to a house or other building, raised to the height of the door-sill and approached by a flight of steps, the same width as the stoop. The word is Dutch, having its origin in New York in Colonial days. It is frequently used incorrectly for porch or veranda.

STOPPAGE IN TRANSITU, *in law*, is the exercise of a right allowed by law to a seller to stop the delivery of goods purchased by a buyer who has become bankrupt while the goods are in the hands of a carrier or middleman for transmission. Under the laws of England it is not necessary that the vendee should have been judicially declared bankrupt or insolvent; mere inability to pay his debts as they become due constitutes the insolvency contemplated by the law. Of course the burden of proof rests on the seller to establish the fact of insolvency or bankruptcy in case it is denied. Stoppage in transitu is not held to cancel the transaction, but only to place the goods under lien of the seller for the price. The transitus, during which goods are liable to stoppage, is terminated by actual or constructive delivery to the buyer or his agent. A common carrier is not considered the agent of the buyer, although employed by him for the transmission of the goods; but if goods are delivered at a shipping port to a buyer's agent for transshipment, the tansitus is at an end and cannot be renewed when they are redelivered to a common carrier. Although the buyer is the charterer for the voyage of the ship in which the goods are carried they are not held to be delivered to him until the delivery is completed in the usual manner at the close of the voyage; but if he has hired the ship for a period it will be considered as his premises and the delivery will be complete. The law of the United States in relation to this subject is virtually the same as that of England.

STORAGE BATTERIES. See ELECTRIC STORAGE BATTERY, THE.

STORE CHECKS. See TRUCK SYSTEMS.

STORER, Bellamy, American diplomat: b. Cincinnati, 28 Aug. 1847. He was graduated from Harvard in 1867, and from Cincinnati Law School in 1869. He practised law in Cincinnati; was a member of Congress, 1891–95; United States Minister to Belgium, 1897–99; to Spain, 1899–1902; United States Ambassador to Austria-Hungary, 1902–06, when a controversy with President Roosevelt over ultra-diplomatic activities led to his resignation. Consult Storer, B., ‘Letter to the President and the Members of his Cabinet’ (1906).

STORER, David Humphreys, American physician and naturalist: b. Portland, Me., 26 March 1804; d. Boston, Mass., 1891. He was graduated at Bowdoin College in 1822, studied medicine at Harvard Medical School, then started to practice (1825) in Boston and continued till 1888. He was called to the chair of obstetrics and medical jurisprudence in 1854, in Harvard Medical School, becoming dean from 1855 to 1864. In 1866 he became president of the American Medical Association. He wrote ‘Report on the Ichthyology and Herpetology of Massachusetts’ (1839); ‘Synopsis of the Fishes of North America’ (1846), long the standard on this subject. In 1876 he was awarded the degree LL.D., by Bowdoin.

STORER, Francis Humphreys, American agricultural chemist: b. Boston, Mass., 27 March 1832; d. 1914. He was son of David H. (q.v.). He studied chemistry under Prof. J. P. Cooke, becoming his assistant in 1851, and was graduated at Harvard in 1855 after returning from an exploring expedition of the United States to the North Pacific. He next went to Europe and studied under Bunsen at Heidelberg, Richter at Freiberg, Stoeckhardt at Tharund, and Emil Kopp in Paris. On his return (1857) he became chemist to the Boston Gas Light Company while working in a private laboratory. In 1865 he became professor of general and industrial chemistry at the Massachusetts Institute of Technology. He was appointed, in 1870, professor of agricultural chemistry at Harvard University and became (1871) dean of the Bussey Institution. In conjunction with Cyrus M. Warren he made notable researches upon hydrocarbons. While at the Massachusetts Institute of Technology he developed, in collaboration with Charles W. Eliot, a system of teaching applied arts chemistry; together they published ‘Manual of Inorganic Chemistry’ (1868), setting forth their advanced method of training, which became very popular. Other valuable works were ‘A Dictionary of Solubilities of Chemical Substances’ (Cambridge 1864); ‘Manual of Qualitative Chemical Analysis’ (1868; 17th ed. 1893); ‘A Cyclopædia of Quantitative Analysis’ (1870–73); ‘Elementary Manual of Chemistry’ (1894); ‘Agriculture in Some of its Relations with Chemistry’ (3 vols. 1897); ‘Manual of Qualitative Analysis’ (1899).

STOREY, George Adolphus, English artist and author: b. London, 7 Jan. 1834. He first exhibited at the Royal Academy in 1852. In 1863 he was in Spain, painting portraits at Madrid. Among his pictures are ‘A Royal Challenge’ (1865); ‘After You’ (1867); ‘The Shy Pupil’ (1868); ‘The Old Soldier’ (1869); ‘The Duet,’ and ‘Only a Rabbit’ (1870); ‘Rosy Cheeks’ and ‘Lessons’ (1871); ‘Little Butter-Cups’ (1872); ‘Caught’ (1875); ‘A Dancing Lesson’ (1876); ‘The Ivory Door’ (1881); ‘Coracles on the Dee’ (1882); ‘The Connoisseur’ (1883); ‘First Practice’ (1894); ‘Rival Minstrels’ and ‘Coming Events’ (1895); ‘A Love Stratagem’ (1896); ‘A Fair Musician’ (1897); ‘Daughter of the Regiment’ (1897); ‘In Evening Shade’ (1898); ‘The Lost Labour of the Danaides’; ‘Philomel’ (1900); ‘The Love Letter’ (1901); ‘A Love Sonnet’; ‘Miss Reynolds’ (1902); ‘Pluto’s Messenger’ (1904); ‘Venus Lamenting the Death of Adonis’; ‘Griselda’ (1905); ‘Leda,’ ‘Pamela,’ etc. (1906); ‘Mrs. E. W. Meyerstein’ (1907); ‘Phryne’ (1908); ‘Circe,’ ‘Pan and Syrinx,’ and ‘Phillis Meyerstein’ (1909); ‘My Mother’s Portrait,’ purchased for the National Gallery of British Art; ‘My Father’s Portrait’ (1874); ‘Lady in Furs’; ‘Miss Gladys Storey’ (1912); ‘Her First Letter’ (1913); ‘A Young Painter,’ ‘Edward Cressy’; ‘Armida in the Enchanted Wood’ (1914); ‘Viola’ (diploma work), ‘Diana’ (1915). He is author of ‘Sketches from Memory’ (1899); ‘Theory and Practice of Perspective’ (1910).

STOREY, Moorfield, American lawyer: b. Roxbury, Mass., 19 March 1845. He was graduated from Harvard University in 1866 and from the Harvard Law School three years later. He was private secretary to Charles Sumner 1867–69, and from 1873–79 was editor of the *American Law Review.* He was active in the “Mugwump” movement in 1884 and was president of the American Bar Association in 1896. He has published ‘Life of Charles Sumner’ (1900), and a ‘Memoir’ of E. R. Hoar (1911).

STORKS, a family (*Ciconiidæ*) of wading-birds of the order *Herodiones.* In this family the bill is very stout at the base, longer than the head, usually straight but occasionally curved either up or down. The nostrils are remarkable in being entirely unprotected either by a scale or bristles; they are placed close to the base of the bill and perforate its horny sheath directly, not being even sunk in a groove. The hallux is placed on a level with the other toes which are either moderately or considerably elongated and terminate in a more or less flat, broad claw. The general aspect of these birds is somewhat heron-like but they lack all of the grace of those birds, being of rather heavy build and clumsy action. To this family belong the true storks, the jabirus and the wood ibises, the latter being quite distinct from the true ibises. True storks form the subfamily *Ciconinæ* and, with the exception of the closely related American jabirus, are confined to the warmer parts of the Old World, where about six genera occur. The white stork (*Ciconia alba*), which during some portion of the year is found in most parts of Europe, Asia and Africa, is the celebrated bird of German and Dutch story and folklore, and familiar from the pictures in children’s Christmas books of German manufacture. In its domesticity and love of human habitations as nesting-sites it departs widely from the solitary, retiring habit of most of its kindred; but in other respects it is thoroughly a stork, feeding upon frogs, small fishes, mice and insects, which are captured in the marshes and meadows; sleeping during the heat of the day often with one foot drawn up and the bill lying on the breast; becoming active at dusk and in the cool of the morning; voiceless but producing a clattering noise with its bill; during the mating season indulging in dances and other queer stiff-legged antics; and on the approach of cold weather migrating to Africa. They fly in pairs or small flocks at a great height and with their long legs stretched out straight behind. A stork's nest on the house-top is the best of good omens and as the birds are undisturbed they return year after year to add to the huge structure of sticks and raise another callow brood. Other species of the same genus inhabit Europe, Asia and Africa, but they breed on rocky cliffs or tall trees and shun human habitations. The adjutant (*Leptoptilus dubius*) of India is another semi-domesticated species which acts as a scavenger and feeds largely upon carrion. A very peculiar Indian stork is the open-bill (q.v.) in which the mandibles do not completely close. Its food consists largely of mussels. But two species (*Dissura maguari* and *Mycteria americana*) inhabit America, the last only, the jabiru, entering occasionally the southernmost United States. It is a large bird, standing more than four feet high, with a huge, massive bill more than a foot long, the head and neck bare and black except for a bright red zone on the lower part of the latter; the plumage is entirely white. The young are largely grayish. Along the seacoast and about the mouths of some of the rivers of tropical South America this bird is very abundant. Besides capturing living reptiles, frogs, etc., it feeds upon carrion and has a curious habit of probing the mud with its bill in search of worms and larvæ. Its nest, a platform of sticks, is built in tall trees and two dull green eggs more than three inches long are laid. When angered or excited the crop is inflated beneath the red skin of the throat which swells out like a huge ball of a most threatening aspect. The wood ibises form the subfamily *Tantalinæ*, distinguished from the true storks chiefly by the strongly decurved bill and longer claws. *Tantalus* is generally considered to be the only genus, with species in tropical Africa, India and the Malayan Islands, and the American *T. loculator* which inhabits the entire South American continent and the southern United States, occasionally straying northward to Pennsylvania and New York. Except that it is gregarious, especially when breeding, its habits are stork-like. In the Southern States the wood ibis is resident in thickly wooded swamps, along the seashore, rivers and bayous where it is extremely abundant in many places. In Florida, however, it is said to be more solitary. When feeding it rakes the bottom with its hooked bill and captures the small fishes, worms, mollusks and crustaceans thus disturbed; in fresh water it captures especially crayfish and batrachians, and on land snakes, lizards and rats. The two or three eggs are dull white. The stork is the omen of births, and "to receive a visit from the stork" means to have a new baby in the family. Consult 'Newton Dictionary of Birds' (London 1896); Gubernates, 'Zoological Mythology' (New York 1872); Baird, Brewer and Ridgway, 'North American Water Birds' (Vol. I, Boston 1884).

STORM, stŏrm', **Theodore**, German novelist, poet and short story writer: b. Husum, a seaport and manufacturing town of Schleswig, on the coast of the North Sea, 14 Sept. 1817; d. Hademarschen, 4 July 1888. He studied law at Kiel and Berlin and practised his profession in his native town. On account of his strong German sympathies in the Schleswig-Holstein question he was forced to leave the country and was a political exile for 10 years (1854–64). When the disputed territory passed under the dominion of Prussia in the latter year he was permitted to return and was rewarded with several judicial positions under the Prussian government for his faithfulness to the German cause, and he was finally retired on a government pension in 1880. His most popular story is 'Immensee'; but it is only one of half a hundred which were received with satisfaction by the German reading public. In this story he recalls, in a strangely vivid, poetical, realistic, yet dreamy, fanciful manner, the scenes of his early life. Almost all his stories and poems are touched with the same quiet sadness as that which characterizes 'Immensee.' This loneliness and melancholy surround most of the people about whom he writes. Yet through this strange loneliness there is ever in evidence an engaging warmness of heart and tender sentiment expressed in sweet and graceful language. Everywhere we feel, in the stories, novels and poems of Theodore Storm, that he expresses much more by suggestion than he actually says; and this characteristic forms one of the chief charms of his works. Storm may be called the prose Longfellow of Germany. See IMMENSEE.

STORM, The ('Groza'). In this tragedy, which appeared in 1860, Ostrovski has given the most vivid picture in literature of the frightful consequences of domestic despotism, such as formed the foundation of the lives of the Moscow merchant class. The old widow Kabanikha believes in the rule of terror and cannot understand her son's sentiment that his wife should not live in fear of him. Catherine, his wife, who is the heroine of the play, has by the critic Dobrolyubov been denominated "a ray of light in a world of darkness." She is one of the most touching characters in any literature. Warmhearted, profoundly religious, her nature is chilled in her home surroundings by the hostility of her stern mother-in-law and the indifference of her profligate husband. She begs him not to go on a journey, not to rob her of her soul's peace. During his absence she is easily captivated by the urbane Boris, and she falls. Upon her husband's premature return a raging storm evokes in her mingled feelings of superstition and remorse, and she confesses to her husband. When she hears that Boris is forced to leave for a long journey she, in a sense comparable to the finest scenes in Goethe's 'Faust,' bids him good-bye and then commits suicide by leaping into the river. The positive characters in the play are Catherine's family, among whom she had been brought up in love, and the autodidact Kuligin, who gives expression to Ostrovski's humane sentiments in some such way as did the chorus in the ancient Greek tragedy. In Russia this drama has maintained itself on the repertoire until the present time, but it has not met with success abroad, on account of the great objectivity of the characters and the absence of climaxes and melodramatic situations. It is to be found in an English translation by Constance Garnett (London 1899 and Boston 1907).

LEO WIENER.

STORM KING, or **BUTTER HILL** (called by the early Dutch *The Klinkenberg*, which means "Echo Mount"), one of the highest peaks of the Highlands on the west bank of the Hudson, in Orange County, N. Y. It was also called Boterberg (Butter Mountain) by the Dutch. It is a rounded mass (1,530 feet high), made more conspicuous by being on the river's bank. The village of Cornwall is near by. The peak stands like a «storm king» at the northern «Gate of the Highlands,» as a protection against the fierce storms of the north.

STORM-PETREL. See Mother Carey's Chicken.

STORM AND WEATHER SIGNALS. See Meteorology; Weather Bureau.

STORNOWAY, stôr'nō-wā, Scotland, a seaport in Ross and Cromarty County, on the east coast of the island of Lewis, Outer Hebrides. The principal buildings are the courthouse, assembly-rooms, public library, customs house, drill-hall, industrial and grammar schools. There is a naval reserve station, a good harbor with quays and wharves, and a ship-building yard with patent slip. The herring and whitefish fisheries are valuable. The town has a population of about 4,000, and the parish of about 14,000.

STORRS, stôrz, **Richard Salter,** American Congregational clergyman: b. Braintree, Mass., 21 Aug. 1821; d. 5 June 1900. He was descended from a long line of ministers; was graduated at Amherst in 1839, and at the Andover Theological Seminary in 1845. He preached for a year in Brookline, Mass.; and in 1846 became minister of the Church of the Pilgrims, Brooklyn, N. Y., continuing in that pastorate until his death. He reached a commanding position among the leading preachers of his time, and added new meaning and dignity to the title of pulpit orator, which by eminence he bore, although his oratory was free from limitations of a professional character, being effective through its intellectual and moral qualities and its masterful delivery, whatever the subject or the occasion might be. He was also a scholar and writer of much distinction, and contributed articles on various subjects to many publications. From 1848 to 1861 he was one the editors of the *Independent*. He also published ‘The Graham Lectures on the Wisdom, Power and Goodness of God, as Manifested in the Constitution of the Human Soul’ (1856); ‘The Conditions of Success in Preaching Without Notes’ (1875); ‘The Divine Origin of Christianity Indicated by his Historical Effects’ (1884); ‘Bernard of Clairvaux’ (1892); ‘Forty Years of Pastoral Life’; and also many religious, historical and literary discourses of varied interest. From 1887 to 1897 he was president of the American Board of Commissioners for Foreign Missions. Consult Storrs, Charles, ‘The Storrs Family’ (New York 1886).

STORRS, William Lucius, American jurist and congressman: b. Middletown, Conn., 25 March 1795; d. Hartford, Conn., 25 June 1861. He was graduated (1814) at Yale College and admitted (1817) to the New York bar, soon returning to practice at Middletown. He was elected member of the State assembly (1827–29) and again in 1834, when he became speaker the last term. From 1829–1833 he was member of Congress for Connecticut, and again in 1839–41, when he resigned to become judge of the Supreme Court of Connecticut, serving till 1856. From the latter date till his death he was chief justice of the Supreme Court of Connecticut. From 1846–47 he was professor of law in Yale College. Western Reserve conferred the degree of LL.D. on him in 1846. His decisions may be found in the ‘Connecticut Reports.’

STORTHING, stôr'ting, the parliament or legislative assembly of Norway. It is elected triennially, and holds annual sessions. See Norway.

STORY, George Henry, American artist: b. New Haven, Conn., 22 Jan. 1835. After serving three years' apprenticeship to a wood carver he studied under Charles Hines for a like period. He next spent a year in Europe, after which he went to Portland, Me., where (1859) he received the State medal. In 1863 he settled in New York, where he has painted many notable portraits and genre pictures. At the Philadelphia Centennial Exposition he was awarded a medal. From 1889–96 he was curator of the department of paintings at the Metropolitan Museum of Art, New York, becoming acting director 1904–05, and has been curator emeritus since 1906. He received A.N.A. diploma in 1875.

STORY, Joseph, American jurist: b. Marblehead, Mass., 18 Sept. 1779; d. Cambridge, Mass., 10 Sept. 1845. He was graduated from Harvard in 1798, and afterward studied law. In 1808 he entered Congress, in 1811 became speaker of the Massachusetts State legislature, and soon after was appointed a judge of the United States Supreme Court. In 1829 he became first Dane professor of law at Harvard, a position which he held for the rest of his life, while he still continued to serve as judge of the Supreme Court. He was strongly opposed to slavery, and for this reason he was very unpopular where the slavery sentiment prevailed. As a judge of the Supreme Court he made a mark for himself and helped to largely mold American equity jurisprudence. Many editions of his law works have been published, and they are still consulted. His law works include special treatises, commentaries and judgments. A collection of his miscellaneous writings was published in 1852. Among the legal works are ‘On the Law of Bailments’ (1832); ‘On the Constitution of the United States’ (1833); ‘On Equity Jurisprudence, as Administered in England and America’ (1836); ‘On the Law of Agency’ (1839); ‘On the Law of Partnership’ (1841); ‘On the Law of Bills of Exchange’ (1843), and others. In his constitutional opinions he was of the school of Washington and Chief-Justice Marshall, advocating just powers for the Union without encroachment upon the rights of the respective States. His judgments in the Supreme Court may be found in the reports (1811–45) of Wheaton, Cranch, Howard and Peters. Consult ‘Life and Letters’ (1851) by his son William Wetmore Story (q.v.).

STORY, Julian, American artist: son of W. W. Story (q.v.): b. Oxford, England. He was educated at Eton and Oxford, studied art at Paris, and in 1889 received the third class medal at the Paris Salon; in 1891 he took the gold medal at the Berlin Exhibit and in 1900 was awarded the silver at the Paris Exposition. The same year he was made Chevalier of the Légion d'honneur of France.

STORY, (Mrs.) William Cumming, American women's club leader. She is an active worker in patriotic societies as well as women's clubs, and was elected president-general of the Daughters of the American Revolution, 1913. She has served as president of the New York City Federation of Women's Clubs, vice-president New York State Federation of Women's Clubs, etc. Her maiden name was Daisy Allen.

STORY, William Edward, American mathematician: b. Boston, Mass., 29 April 1850. He was graduated (1871) at Harvard, and studied (1871–75) medicine at the universities of Berlin and Leipzig, receiving the diploma of Ph.D. From 1875–76 he was tutor of mathematics at Harvard, becoming successively associate, assistant professor and associate professor of mathematics at Johns Hopkins (1876–89). Since 1889 he has been professor of mathematics at Clark University. He has been editor-in-charge *American Journal of Mathematics* (1878–82) and editor *Mathematical Review*. Many valuable articles on mathematical questions have been contributed by him to the leading American, English and German scientific periodicals.

STORY, William Wetmore, American sculptor and author: b. Salem, Mass., 19 Feb. 1819; d. Vallombrosa, near Florence, Italy, 7 Oct. 1895. He was graduated from Harvard in 1838, from its law department in 1840, was admitted to the bar at Boston, and published treatises ‹On the Law of Contracts› (1844); and ‹On the Law of Sales of Personal Property› (1847), besides three volumes of ‹Reports of Cases Argued and Determined in the Circuit Court of the United States for the 1st Circuit› (1847). Two volumes of ‹Poems› appeared in 1847 and 1856. In 1848 Story went to Rome, where he afterward chiefly resided as a sculptor and writer. He was United States commissioner on fine arts to the Paris World's Fair of 1879. Among the better examples of his art are statue of Cleopatra (1864); busts of Lowell, Josiah Quincy and Theodore Parker; a statue of Everett in the Boston Public Gardens; a statue of George Peabody for London (1869), placed in replica in Baltimore in 1888; ‹Saul›; ‹Jerusalem›; ‹Semiramis› (1874). Two of his sons, Julian and T. Waldo, were noted in art, the first being a painter and the second a sculptor. Of his further books may be mentioned ‹Roba di Roma› (1862); ‹Graffiti d'Italia› (1869); ‹The Tragedy of Nero› (1875), and ‹Fiammetta› (1885). Consult James, Henry, ‹William Wetmore Story and His Friends› (Boston 1903); Phillips, M. E., ‹Reminiscences of William Wetmore Story› (New York 1898); Taft, Lorado, ‹History of American Sculpture› (New York 1903).

STORY, or **STOREY,** *in architecture,* a floor of a house or other building, or a set of rooms on the same level or floor. A story is considered the distance from floor to floor, usually 9, 12 or 16 feet apart.

STORY OF A BAD BOY, The, by Thomas Bailey Aldrich, takes high rank among the books in which American authors have recounted in the guise of fiction some of their boyhood experiences — a list that includes among others Mark Twain's ‹Tom Sawyer,› William Dean Howells's ‹A Boy's Town,› and Charles Dudley Warner's ‹Being a Boy.› In ‹The Story of a Bad Boy› the author has thinly disguised his name as Tom Bailey, and that of his native town, Portsmouth, as Rivermouth. The seaside setting gives the narrative a flavor as distinctive as that afforded by Tom Sawyer's Mississippi environment. None of the escapades of the bad boy and his friends are in themselves remarkable, but they are told with a thorough understanding of boy psychology, and a pervasive but restrained humor, so that they hold the interest of readers of all ages. Only those of mature years may be able fully to appreciate the satire of a chapter like «I become a blighted being,» in which Tom tries hard to make his love-sickness overcome the healthy appetite and interests of a boy, but those of Tom's own age can see the humor of the situation, and may even find their understanding aided by secret recollections of their own experiences. The one tragic occurrence, the helpless drifting out to sea of little Binny Wallace, is told with remarkable power. Aldrich was always an artist in prose as well as in verse, and his perfection of form and the charm of his style are seen to advantage in this book. It seems likely to last longer than any of his other prose works with the possible exception of one or two short stories.

William B. Cairns.

STORY OF GÖSTA BERLING, The, a novel by Selma Lagerlöf, appeared about Christmas-time 1891. In the summer of 1890 a Swedish magazine, the *Idun*, had offered a prize for the best novel of a certain length. Selma Lagerlöf entered the contest with a few chapters from ‹Gösta Berling,› a story which was then beginning to take shape in her mind, and won the prize. In ‹Gösta Berling› Selma Lagerlöf is a romanticist and represents a reaction against the realism which prevailed at the time. As a child she had absorbed the folk tales of her surroundings, and later on in life it occurred to her like a lightning flash that it was her particular mission to give these stories expression. ‹The Story of Gösta Berling› has been called the «prose epic of Swedish country life.» The scene is laid on the shores of Lake Fryken (Lake Löven in the story) in Värmland. The hero, Gösta Berling, is a deposed minister, who has been saved by the Mistress of Ekeby from freezing to death and thereupon becomes one of her pensioners in the manor at Ekeby. As the pensioners finally get power in their own hands, they manage the property as they themselves see fit, and their lives are filled with many wild adventures. Gösta Berling is the leading spirit, the poet, the charming personality among a band of revelers. But before the story ends, Gösta Berling is redeemed, and even the old Mistress of Ekeby is permitted to come to her old home to die. In this as in her other works, the authoress shows a marvelous simplicity of style. Everything she touches quickens with new life and takes on a deeper meaning. Consult Ruben Berg, ‹Svenska skalder från nittiotalet’; Johan Mortensen, ‘Selma Lagerlöf.’

JOSEPH ALEXIS.

STOTHARD, stŏth'ạrd, **Thomas**, English painter: b. 17 Aug. 1755; d. 27 April 1834. He very early exhibited a taste for drawing. At eight he was placed at school at Stretton, near Tadcaster, where he remained till his 13th year, when he was removed to a boarding-school at Ilford, Essex. On his father's death, about a year after, he was bound apprentice to a drawer of patterns for brocaded silks in London. His apprenticeship was cut short in consequence of the decline of the trade. In 1777 he became a student at the Royal Academy, and in the following year exhibited as his first picture there ‘The Holy Family.’ In 1791 he was elected an associate of the Academy and in 1794 he became an academician. Among his works may be mentioned his designs for novels by Richardson, Fielding, and Smollett; for Sterne's ‘Tristram Shandy’; for Milton's works; for Rogers' Poems and ‘Italy’; some historical pictures and his Canterbury Pilgrims. He painted internal decorations of buildings and designed silver plate, medals, etc. He is said to have made 5,000 designs, 3,000 of which were engraved. Consult ‘Life’ by Mrs. Bray (London 1851) and a second by A. C. Coxhead (London 1906).

STOTT, Henry Gordon, American electrical engineer: b. Orkney Islands, 1866. He studied at the College of Science and Arts, Glasgow, and at the Glasgow and West of Scotland Technical College. He served (1884) with the Glasgow Electric Light Company and (1885–89) with the Anglo-American Telegraph and Cable Company, experimenting at the same time. He was (1889–90) assistant engineer for Brush Electric Engineering Company's plant at Bournemouth, England, then on electric works (1890–91) at Madrid, Spain. From 1891–1901 he was engineer of the Buffalo General Electric Company. Since 1901 he has been superintendent of motive power Interborough Rapid Transit Company and New York Railways Company.

STOUGHTON, stō'tọn, **Israel**, American colonist: b. England at the close of the 16th century; d. Lincoln, England, 1645. He emigrated to America in 1630 with the company which founded Dorchester, Mass., of which John Endicott was a conspicuous figure, and served the colony as assistant to the governor during a number of years. He was identified with the famous antinomian controversy introduced by Ann Hutchinson and Wheelwright, and having written a pamphlet upon the subject which was displeasing to his fellow townsmen he was removed. He was later restored to his place in the government of the community. In 1639 he was appointed to act with Endicott in a boundary dispute with the Plymouth colony, but in 1644 he left Massachusetts and returned to England where he later on entered the Parliamentary army as lieutenant-colonel. By will he left 300 acres in Dorchester to Harvard University. Consult Quincey, Josiah, ‘The History of Harvard University’ (Boston 1860).

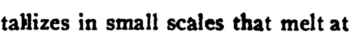
STOUGHTON, William, American colonist, son of Israel Stoughton: b. about 1630; d. Dorchester, Mass., 7 July 1701. He studied at Harvard and was afterward graduated at Oxford, where he was fellow from 1652 to 1660 when he was dismissed as a result of the Restoration. Returning to America, he was elected assistant in the Dorchester colony from 1671 to 1686. In 1692 he was appointed lieutenant-governor of Massachusetts, and in this capacity presided over the witchcraft trials at Salem, and he treated the accused with great cruelty. He seems, notwithstanding his travels and education, to have been a man of very narrow calibre. Following the example of his father, he became a liberal patron of Harvard University. Consult Sibley, J. L., ‘Biographical Sketches of Graduates of Harvard University’ (Cambridge 1873).

STOUGHTON, Mass., town in Norfolk County, on the New York, New Haven and Hartford Railroad, 16 miles south of Boston. Within its limits are the villages of Stoughton, West Stoughton and North Stoughton. The chief manufacturing establishments are woolen mills, rubber works, boot and shoe factories and machine shops. The town has one public high school, 17 district schools, several private schools and a public library, established in 1874. There are several beautiful residential sections and in the southern part of the city are small bodies of water. Pop. over 7,000. Consult Hurd, ‘History of Norfolk County’ (Philadelphia 1884).

STOUGHTON, Wis., city in Dane County, located on the Catfish River and on the Chicago, Milwaukee and Saint Paul Railroad. It is 15 miles south-southeast of Madison. It has a Carnegie library and manufactures of plows, carriages and wagons, flour mills, etc. Pop. 4,761.

STOUT, George Frederick, English psychologist: b. South Shields, 6 June 1859. He was educated at Saint John's College, Cambridge, of which he became a fellow in 1884. He was Anderson lecturer in comparative psychology at the University of Aberdeen in 1896, and previous to that lecturer on moral science at Cambridge (1894). He became professor of logic and metaphysics in Saint Andrews University in 1903. He was Wilde reader in mental philosophy at the University of Oxford (1898); examiner at London University (1899) and Gifford lecturer at the University of Edinburgh (for 1918–20), and has been editor of *Mind* from 1891. He has published ‘Analytic Psychology’ (1896); ‘Manual of Psychology’ (1899) and other similar works.

STOVAINE. This chemical is amylocaine or dimethyl-amino-benzoyl-ethyl-carbinol hydrochloride and its formula is



$$\begin{matrix} CH_3 \\ C_2H_5 \end{matrix} > C < \begin{matrix} O.CO.C_6H_5 \\ CH_2\,N(CH_3)_2\,HCl. \end{matrix}$$

It crystallizes in small scales that melt at 175° C. It is freely soluble in water, dilute alcohol and acetic ether, slightly soluble in absolute alcohol. Its therapeutic value is as a local anæsthetic (substitute for cocaine). The claims in its favor are that it is a vaso-dilator rather than vaso-constrictor and has but half to one-third the toxic power of cocaine. When administered subcutaneously it is not an anodyne, but produces analgesia in epidural or epidermal injections, especially in cases of neuralgia, including sciatica. It is favored in ocular surgery for its rapid action. Dentists employ stovaine preceding extractions.

STOVES AND HEATING APPARATUS. Any system of heating must necessarily include three things, the combustion of fuel in a fireplace, stove, furnace, steam or hot-water boiler; a system by which the heat is transmitted to its destination with the least possible loss; and a system of diffusion, by which the heat is conveyed to the air in a room, and to its walls, floors, ceilings, etc. The simplest and most economical method of heating to instal is the stove, which requires no system of transmission, but by radiation and convection diffuses the heat directly to the air and to the objects in the room. Though this method has not been entirely superseded in dwellings by the hot-air furnace, owing to the cost of installing the latter, the furnace has largely done away with use of the stove solely as an apparatus for heating purposes, beside which the furnace has many advantages over the stove, as such. The hot-air furnace is generally constructed of brick or iron plates and provided with a brick-lined firepot; there is a combustion chamber over the fire, and between these latter two and the outside casing is left a space for the circulation of air. Through a box or pipe, called the “cold-air box,” located at the bottom of the casing, fresh air is brought from outside, enters the space between the casing and the firebox, passes over the heated surface of the firepot and combustion chamber, and, by means of pipes at the top of the casing which connect with the registers, is transmitted to the various rooms of the house.

The furnace in its turn was followed by the steam boiler which transmits the steam to radiators throughout the house, and from them the heat is diffused to the air in the room. This method of heating has come into use largely as the office building has been increased in size, and the majority of such buildings are now heated by steam. Gas and oil stoves have also become valuable as means of heating isolated rooms in a building or house, not otherwise connected with any heating appliances.

Stoves.—In 1490 the first stove was reported as being made in Alsace, and in 1509 others were cast in Islenberg. The first blast furnace erected in this country at Lynn, Mass., in 1642, turned out a small round-bottomed kettle with a cover, probably the first stove of any description made in this country. The industry lagged for nearly a century, and it was not till the middle of the 18th century that the manufacture was pushed to any great extent. About 1735 Christopher Sower, of Germantown, Pa., began to manufacture the jamb-stove, which was the first attempt to heat other rooms than the one in which the great brick fireplace was located. This jamb-stove consisted of a cast-iron box built into the side of the kitchen fireplace, one end opening in the adjoining room, the other being heated by the fire, so that when the door of the jamb-stove was opened, a small amount of heat was transmitted to the room.

In 1744 the manufacture of Franklin stoves was commenced in Philadelphia. This stove, the invention of Benjamin Franklin, consisted of a cast-iron open fireplace, jutting out from the chimney, and thus the heat was thrown out from three sides into the room, instead of only the one side, as in the jamb-stove. Between 1752 and 1760 the six-plate, or box-stove, which was the pioneer of the many modern forms of heating apparatus, was made in Marlboro, Va. Stoves were made in 1760 by Baron Steigel of Letitz, Pa., and in 1786 box-stoves were made in Philadelphia, but were not put together there, that work being done at Providence, R. I., and Troy, N. Y., whither the plates were shipped. In 1802 Isaac Orr began the manufacture of the cylindrical or oval stoves of sheet iron at Philadelphia and in New Hampshire. This was the forerunner of the oval regulator stove, having a fire-damper, automatically opened and closed by the difference in expansions of a brass rod and the sheet-iron stove-body. In 1820 the Conant stove was made at Brandon, Vt., and the Woolson stove soon followed, being first made at Brandon, but they were later manufactured in Massachusetts, Cleveland and Detroit. In 1836 a stove having an illuminated case of cast iron and mica, enclosed flues, a check-flue and a direct draft damper, was made by James Atwater of New York, and almost simultaneously the Stanley square heating-stove was brought out. The cylinder-stove, invented by Dr. Bushnell in 1845, except for the fact that it was cylindrical and the inside was lined with fire-clay, was similar to the Stanley stove, the latter having return and exit flues enclosed in the four corners, whereas the former had a pipe at the back through which the heat made its exit after having come down the four pipes or flues in the corner to the hollow base. The next in succession was the round or oval gas burner or surface burner, made of sheet iron, and having the flues which returned the heat to the base enclosed in the body of the stove. It should be understood that these “gas-burning” stoves consumed coal, the reason for the name “gas-burning” being that they were assumed to consume all the gas emitted by the coal. In these gas-burners also the coal was more thoroughly burned out by having perforated firepots and perforated gas rings at the top of the brick. Fuller, Warner and Company of Troy, N. Y., made the style of oval and round parlar stoves most generally used, the P. P. Stewart.

The base-burner has been in use for many years, one of the first to be constructed being the self-feeder, patented by Jordan L. Mott, Sr., of New York, in 1833; the plan of his stove being to feed the coal from a magazine to the firebox, and to use the chestnut size of anthracite coal. This was followed in 1852 by the self-feeding base-burning stove, and in 1862 by the “Morning Glory,” both of which were the inventions of D. G. Littlefield of Albany, N. Y.; then came the “American” of Van Wormer & McGarvey of Albany, N. Y., and in 1863 the revertible-flue gas-burner with the magazine attachment, the production of Hailes and Treadwell, in Albany. Since then there have been innumerable styles of stoves introduced, with many more or less valuable changes and additions. The following are the most important of these: the base-burner having a small mica window opposite the grate, by Hunt and Miller of Hudson (1865); the anti-clinker direct draft base-burner, by James Spear of Philadelphia (1871); "Keep's Side-Burner," having a full mica section below and above the firepot, by W. J. Keep (1871); the "Argand" base-burner, a combination of the "American" with an anti-clinker grate and the full double illumination, by Perry and Company of Albany (1873); the "Splendid" by Fuller, Warner and Company (1875); the "Garland" by the Michigan Stove Company (1876); Keep's square-base and square-sided, round front and round firepot, called the "Art Garland," by the Michigan Stove Company (1884); the "Hub" base-burner, by Smith and Anthony of Boston (1884); the Keep "Reflector Art Garland," by the Michigan Stove Company (1887); and many other makes, including the oval sheet iron stove, known as the "Tamale," and the P. D. Beckwith "Oak" stove, having fluted firepot, steel drum and airtight fittings.

In the cooking stove there has been as much change as in the stove used for purely heating purposes. The pioneer in this line was the James stove, a nine-plate, with the oven on the side of the stove. The next in succession was the Conant stove, invented in 1819, which had the oven directly over the firepot and doors at both ends, but as the fire underneath the oven heated the bottom too quickly, this style was soon abandoned. The Woolson stove of Claremont, N. H., having the oven at the side, the heat being thrown under or over it by means of dampers, was next on the market, but as the fire caused the oven to bake more rapidly on the near side, the oven was next placed at the rear and above the boiler-holes. In 1833, Stanley invented the rotary cook stove, with the cooking holes and firebox on the same level as the oven. The next step along progressive lines came in 1810–20, in shape of an oval stove, the invention of a Mr. Hoxie of Salisbury, Conn., in which the fire, having gone down the two end flues and met at the bottom, passed to the chimney through an aperture in the hearth of the fireplace over which the stove was situated. P. P. Stewart patented two stoves, one in 1828, the other in 1850, in the first of which the firebox was hung in the upper part of the oven, thus throwing off heat from three sides while the flame passed all around the oven on the outside and on the pipe collar on top of the stove. The latter, the large oven stove, had a sheet flue underneath with three flues at the rear. At about the same time, 1850, the curved plate which dumped the ashes from the grate into the pit in the hearth was invented by Samuel Pierce, and since then only minor changes have been made in construction, the water-tanks, reservoirs, grates, etc., being rearranged, various methods of open ventilation, return-flue construction and different styles of ornamentation being introduced.

The improved kitchen cooking stove when of large size was named "range." A sheet-iron range, in which the grate containing the fire was suspended inside a sheet-iron casing, the heat thus coming from the fire direct, was placed on the market in Boston, in 1850, by a Frenchman named Gillette. About the same time a similar range was made in New York by Duparquet, Huot and Moneuse, but they later made a radical change in the construction by placing flues around the oven, as at present, and the oven was made a separate part of the construction. These two were followed, in 1885, by the wrought-iron range of John Van of Cincinnati, but with the many rapid advances made in the manufacture of steel, the use of wrought iron has largely given place to the use of blue polished steel and aluminum painted steel.

The manufacture of stoves is largely carried on in the West — Ohio, Illinois and Michigan being the largest producers. The earliest factories in the East where stoves were made exclusively were at Troy, Albany and New York. The West then began to loom, the first foundry being established in Detroit about 1830, known as the Hydraulic Iron Works, which was followed by Dwyer and Brother in 1861. This firm later became the Detroit Stove Works, which, in 1871, was followed by the Michigan Stove Company, and in 1881 by the Peninsula Stove Company and others. The competition thus engendered between western and eastern manufacturers soon led to the establishment of branch foundries by the eastern people in western cities, and Chicago became the centre of distribution. Later Ohio took the lead, and in 1915 one-fifth of the production of stoves and furnaces was in that State. The statistics of the trade are meagre, but for the year 1900 the output of stoves was valued at $35,446,600, distributed through the States as follows: Pennsylvania, $5,209,000; Michigan, $4,935,000; New York, $4,913,700; Ohio, $4,384,200; Illinois, $3,801,000; Massachusetts, $2,061,800; Missouri, $1,921,000; Indiana, $1,439,500; Tennessee, $1,280,000; Kentucky, $1,044,000; Wisconsin, $972,000; etc.

Thereafter the census placed together the manufacturers of stoves, furnaces, and gas and oil stoves, and the total annual value of the products is over $75,000,000.

Oil and Gas Stoves.— Oil stoves for domestic use became common about 1875. The earlier types were simply large lamps, burning kerosene, and having a fixture on top for supporting a pan, kettle or cooking or heating utensil. Very broad wicks were employed, and a circular burner and wick were also introduced, that gave good results. These oil lamps or oil stoves had to be kept very clean to secure good combustion, as they delivered a great deal of carbon, which tended to clog the mechanism. It was a decided improvement when the vapor-burning stove was later introduced. In this the naphtha or other light product of petroleum was stored in a small metal tank, and led through a pipe to one or more burners — usually a set of burners, arranged like the top of a stove. The aperture to the burner was very small, and the slight stream of naphtha that flowed was easily vaporized, so that after a burner had been lit a minute or less, it ceased to burn oil directly as the pipe near the burner became hot enough to vaporize the oil, and delivered vapor to the burner. This vapor could be mixed with air, on the principle of a Bunsen burner, and thus the consumption of fuel was both economical and safe, for the tank was at a distance from the flame. Oil stoves of a variety of types, utilizing the principles here described, are on the market, and are not only an economical method of heating, but very convenient as to portability. They have the disadvantage, however, of rapidly consuming the oxygen in a small room, and constant ventilation is required to render the air fit to breathe.

Gas stoves have been made and used for a long time, but were never popular until after the general agitation for lower-priced gas had resulted in bringing ordinary illuminating gas resulted in bringing illuminating gas to a price below $1.50 per 1,000 cubic feet. An exception region of the Middle West where they first came into common use in the 60's and 70's. About 1890 the gas companies of the United States began a concerted effort to introduce gas stoves to increase the sale of their commodity. The common type of heating stove offered was of the radiator type, with a row of burners in the base, and large metal tubes directing the heat toward the top, so as to afford plenty of radiating surface. These were made of sheet iron, usually ornamented with nickel, in various sizes, and they have become common for household use, where rooms are not heated by furnace or steam. For cooking purposes, the gas companies have supplied gas ranges, patterned after the coal ranges on top, and as to oven conveniences. Rosette burners are placed where the «holes» are in a coal range, and mixers employed to admit air to the burners, so as to secure hot blue flames, with a minimum consumption of gas. These gas ranges have become very popular with housewives, for they save the dirt and dust of coal and ashes, involve cost only when in actual use and are easily lit and turned out. They are often used in summer time alongside coal ranges, which are allowed to lie idle, the reason being that the gas range creates less heat in the room, and is, therefore, more comfortable. Despite the fact that gas fuel generally costs considerably more than coal, the conveniences of the gas stove and gas range have resulted in a steadily increasing use.

Furnaces.— The first hot-air furnace for supplying pure heated air to rooms was probably that constructed by Franklin in 1744. This was a sheet-iron oblong box, burning wood, the smoke passing into the chimney over the top of the flat chamber behind the fire, and between it and the real back of the stove. The cool air entered this flat hollow chamber through a pipe, and when heated passed through small holes in the side of the chamber into the room. This style of apparatus was not much improved upon till the beginning of the 19th century when in 1808 Daniel Pettibone of Philadelphia took out a patent on a stove for rarifying air by heat. This was followed by the warm-air furnace of William A. Wheeler of Worcester, Mass. (1835); by that of Gurdon Fox of Hartford, Conn. (1835-40); the Blaney and the Culver; the Boynton, made by Richardson and Boynton; the Thatcher and others. The reduction of the price of furnaces has made their use more common, till now nearly every large dwelling-house has one. Furnaces may be divided into two general types, the direct and indirect draft. The better class of direct draft furnaces have a radiator, generally placed in the top, through which the gases pass before reaching the smoke-pipe, and usually have but one damper combined with the cold-air check. In the cheaper styles of direct-draft furnaces, this radiator is done away with, the gas passing directly into the smoke-pipe, but this system wastes much heat that is utilized by the better grade of furnace. In the indirect draft type of furnaces the radiator is located near the base and the gases pass down through flues to it, thence upward and through another flue to the pipe. This style of furnace has a direct-draft damper in addition to the damper in the pipe, thus allowing the gas to escape to the chimney more easily.

The matter of grates and firepots is most important. The most approved form of grate is the revolving triangular pattern, consisting of teethed triangular bars, connected by gears and turned by means of a detached lever. Firepots are usually made of cast iron or of steel plate lined with fire-brick, the pot ranging in depth from 12 to 18 inches. In a wrought-iron or steel furnace this fire-brick lining is necessary because the intense heat may harm the outside shell, but it has not the advantage of giving off heat when the coal is first put on, as does the furnace having the cast-iron firepot.

The combustion chamber, or space above the firepot, should be of sufficient size to allow the gases to become thoroughly mixed with the air passing up through the fire or through the openings of the feed door. The radiator, generally constructed of cast iron or steel plate, is used as sort of a reservoir for the gases and air passing over the furnace, till the air has extracted a considerable portion of the heat from the gas. The cold-air box should be large enough to supply a volume of air sufficient to fill all the hot-air pipes at the same time, the general size or area of the cold-air box being three-fourths the combined area of the hot-air pipes.

Steam and Hot Water.— Heating by means of hot water has been in use since time immemorial, and was known prior to the Christian Era, for Seneca mentions the methods by which water was heated in the Thermæ at Rome, that of passing water through a coil of brass pipes which passed through a fire. This method was used in France in 1777 by M. Bonnemain, and in London, in 1817, by Marquis de Chatannes, for heating a conservatory, and in 1822 an Englishman named Bacon introduced the method of using an inclined pipe of large dimensions, but this was not successful because of imperfect circulation. The first hot-water apparatus introduced in this country was the Perkins system, introduced from England by Joseph Nason in 1842. Hot-water heating in the United States has been an evolution since 1880, the most popular heaters at the beginning of this period being the Gurney and the H. B. Smith. In 1885 the Bolton heater was introduced by the Detroit Heating and Lighting Company, the Mouat heater was the next in succession, and since that time the improvements have been so many and the demand so great that the price of the hot-water plant has been reduced till it is within the reach of the average householder. Hot-water heating is preferred by some to steam because the heat is available as soon as the temperature of the water is higher than that of the room, whereas steam yields no heat until 212 degrees is passed and steam generates, filling the pipes. But in large installations steam is cheaper and has other advantages.

The practice of heating buildings by steam was begun about 1845, the first building to be so heated being the Eastern Hotel of Boston, and the first factory building the Burlington, Vt., Woolen Mill. The system by which these buildings were heated was introduced by Joseph Nason, and consisted of small wrought-iron pipes. From this small beginning have developed the many intricate systems of apparatus now used for warming buildings.

There are two systems of heating by steam, the direct and the indirect, the former being used in all classes of buildings, both by itself and in combination with other systems. The direct system consists of a furnace and boiler for the combustion of fuel and the generation of steam; a system of pipes, by means of which the steam is conveyed from the boiler to the radiators and the condensed water returned to the boiler, and the radiators or coils of pipes placed throughout the rooms of a building for the purpose of diffusing the heat to the air. The types of boilers used are many and various; the cast-iron sectional boiler is more commonly used for dwelling-houses and the tubular or water-tube boiler for larger buildings. In the boiler used for heating purposes only it is not necessary to carry a pressure of more than two to 10 pounds, the condensation flowing back to the boiler by gravity. When under a high pressure, the steam for the heating system is forced through a reducing valve and the condensation returned to the boiler by means of a pump or return trap. The system of diffusing the heat by radiators is not standard, no particular one being of greater benefit than another. There are the common cast-iron sectional radiator; the vertical wrought-iron pipes screwed into a cast-iron base; the cast-iron wall radiator, which does not obstruct the flow, and the coils of iron pipes placed along the ceiling or walls, these latter being of late years ornamented and frequently gilded.

Indirect steam heating has the advantages both of the furnace and of the direct steam, but the cost of installing the system is greater. The main difference between the two lies in the radiator, in the indirect system a special form of heater being placed beneath the floor and encased in galvanized iron or brick work. Connected with the space beneath the heater is a cold-air box and warm-air pipes at the top are connected with registers in the floors or walls as previously described for furnaces, so that the air in passing through the spaces between the sections of the heater becomes warmed and rises to the rooms above. As compared with furnace heating this method has one great advantage, being less affected by outside wind pressure, as long runs of horizontal pipe are avoided and the heaters can be placed near registers. See FURNACE; HEATING AND VENTILATION; ELECTRIC FURNACES; etc.

STOWE, Calvin Ellis, American educator: b. Natick, Mass., 6 April 1802; d. Hartford, Conn., 22 Aug. 1886. He was graduated at Bowdoin College in 1824, and at Andover Theological Seminary in 1828. In 1829 he became an editor of the Boston *Recorder*, but abandoned journalism for the chair of Greek at Dartmouth in 1830. In 1832 he was called to Lane Theological Seminary, Cincinnati, and in the same year was married to Harriet Elizabeth Beecher, author of 'Uncle Tom's Cabin.' He was professor of divinity at Bowdoin in 1850, and in 1852 became professor of sacred literature at Andover, retiring in 1864. His writings include 'The Hebrew Commonwealth' (1829); 'Lectures on the Sacred Poetry of the Hebrews' (1829); 'Introduction to the Criticism and Interpretation of the Bible' (1835); 'Elementary Education in Europe' (1837); 'The Religious Element in Education' (1844); 'Origin and History of the Books of the Bible' (1867).

STOWE, Emily Howard (née **Jennings**), Canadian suffragist and physician: b. South Norwich, Ontario, 1831; d. 1903. She was educated at Provincial Normal School, Toronto, then taught at school. She married John Stowe, of Norwichville, Ontario. In 1867 she was graduated at the New York Medical College for Women and fought all opposition in Canada till admitted (1880) a member of the Ontario College of Physicians and Surgeons, being the first woman physician permitted officially to practice in Canada. The Toronto Woman's Literary and Science Club was organized (1877) by her to become later a suffragist club and (by 1883) widows and spinsters were granted the suffrage at municipal elections in Ontario. In 1893 she organized the Dominion Woman Suffrage Association and was elected its president.

STOWE, Harriet Elizabeth Beecher, American writer: b. Litchfield, Conn., 14 June 1811; d. Hartford, Conn., 1 July 1896. She was a daughter of Rev. Lyman Beecher (q.v.) and sister of Henry Ward Beecher (q.v.). She was educated at Litchfield and then at Hartford, under her sister Catherine, whom she joined in teaching in her school there. In 1832 the sisters removed to Cincinnati, where their father was appointed president of Lane Theological Seminary. In 1836 she was married to the Rev. Calvin E. Stowe, a teacher in the seminary, who in 1850 removed to Brunswick, Me., on being appointed a professor in Bowdoin College, soon after exchanging this post for a similar one at Andover. Mrs. Stowe published in 1843 *The Mayflower*. She had become familiar with the evils of slavery during her residence at Cincinnati, and the work by which her name became known throughout the world—'Uncle Tom's Cabin,' a direct attack upon slavery, was (in 1851–52) contributed in serial form to *The National Era*, an anti-slavery newspaper published at Washington. The story was to some extent based on the experiences of Josiah Henson (q.v.). It was defective in style and construction, but was vividly done. It did not perfectly render Southern life, and the injustice of some of its presentations has been much discussed. It certainly helped to liberate the slave, though its effect was enhanced by political conditions. As a serial it was successful; but it was not until it was published in book form in 1852 that it became famous. In five years over half a million copies of the book were sold in the United States; and its sale in England was very large. It became almost immediately famous, was translated into many foreign languages and published in innumerable editions. In 1853 Mrs. Stowe visited Europe, and this furnished her material for her 'Sunny Memories' published the following year. In 1868 she was associated with Donald G. Mitchell on the editorial staff of *Hearth and Home*. In 1879, when the «Illustrated» edition was published, there were in the British Museum 43 English editions and 19 translations. None of her subsequent works attained anything like the same popularity. Among her works are 'Sunny Memories of Foreign Lands' (1854); 'The Mayflower, and Miscellaneous Writings' (1855); 'Dred: A Tale of the Great Dismal Swamp' (1856); 'The Minister's Wooing,' her most artistic work (1859); 'The Pearl of Orr's Island' (1862); 'Agnes of Sorrento' (1862); 'Reply to the Address of Thousands of Women of Great Britain and Ireland to their Sisters of the United States' (1863); 'House and Home Papers' (1864); 'Stories about our Boys' (1865); 'Little Foxes' (1866); 'Religious Poems' (1867); 'Queer Little People' (1867); 'Daisy's First Winter and Other Stories' (1867); 'The Chimney Corner' (1868); 'Men of Our Times' (1868); 'Oldtown Folks' (1869), a popular study of New England life; 'The American Woman's Home' (1869), with Catherine E. Beecher; 'Lady Byron Vindicated' (1870); 'Little Pussy Willow' (1870); 'Pink and White Tyranny' (1871); 'Sam Lawson's Fireside Stories' (1871); 'My Wife and I' (1871); 'Lives and Deeds of Our Self-Made Men' (1872); 'Palmetto Leaves' (1873); 'Woman in Sacred History' (1873); 'Betty's Bright Idea, and Other Tales' (1875); 'We and Our Neighbors' (1875); 'Deacon Pitkin's Farm, and Christ's Christmas Presents' (1875); 'Footsteps of the Master' (1876); 'Captain Kidd's Money, and Other Stories' (1876); 'The Ghost in the Mill, and Other Stories' (1876); 'Poganuc People' (1878); 'A Dog's Mission' (1881). Consult Field, 'Life and Letters of Harriet Beecher Stowe' (1897); Stowe, C. E., and L. B., 'Harriet Beecher Stowe' (Boston 1911); 'Life,' by her son, C. L. Stowe (ib. 1889). See UNCLE TOM'S CABIN.

STOWELL, Ellery Cory, American professor of international law: b. Lynn, Mass., 12 Dec 1875. He was graduated (1898) at Harvard, traveled (1901–02) in the Orient and Europe, attended the University of Berlin (1903–04) and University of Paris (1904–07). He was appointed secretary of the College of Political Sciences, Washington (1908–09); instructor of international law at George Washington University (1908–10); assistant professor of international law at the University of Pennsylvania (1910–13). He filled the last-mentioned position at Columbia from 1916. From 1910–12 he was assistant editor *Annals of American Academy of Political and Social Science*. In 1907 he was a member attending the Second Peace Conference at The Hague and (1908–09) was secretary of the American delegation of the Naval Conference at London. He has written 'Le Consul' (1909); 'Consular Cases and Opinions' (1909); 'The Diplomacy of the War of 1914' (published in part).

STRABISMUS. See VISION, DEFECTS OF.

STRABO, strā'bō, Greek geographer and historian: b. Amasia, about 64 B.C.; d. 19 A.D. He received a good education and adopted the stoical philosophy. He studied for some time in Rome and was with Aelius Gallus in Egypt and Arabia in 24 B.C. He returned to Rome 20 B.C.; and from this time on made that city his home; though he traveled much, for, as he states himself, he had been from Armenia in the East to Sardinia in the West; and from the Pontus Euxinus on the North. to the borders of Ethiopia. It seems probable that these journeys were made in pursuit of knowledge and information for his literary labors. He wrote a historical work in 43 books, which is lost. It formed a continuation of the history of Polybius to the battle of Actium. The extant fragments of it are collected in Müller's 'Fragmenta Historicorum Græcorum.' His great work on geography, in 17 books, has been preserved entire, with the exception of the seventh book, of which there is only an epitome. It includes notices of important political events and of chief cities and their great men. Eight books are given to Europe, six to Asia, one to Egypt and Libya. Internal evidence shows that he did not complete the plan he had laid out for this work. The best critical edition is that by Kramer (Berlin 1844). Consult Dubois, 'Examen de la Géographie de Strabon' (1892); Hamilton, 'A Translation of Strabo's Geography.'

STRACHAN, John, Canadian bishop: b. Aberdeen, Scotland, 12 April 1778; d. Toronto, Canada, 1 Nov. 1867. He was educated at grammar school, then (1793) at King's College, Aberdeen. While continuing his studies at the college he taught at schools, till he was graduated in 1797. In 1799 he went to Canada to take charge of a new college projected by Governor Simcoe at York (near Toronto). The project failing, he took to teaching at a private school at Kingston which he established. He abjured his adherence to the free church and joined the Church of England and was ordained minister in 1803, becoming curate at Cornwall. In 1807 he was made LL.D. of Saint Andrew's and (1811) D.D. of Aberdeen. He was made (1812) rector of York (Toronto) and chaplain to the troops as well as master of the grammar school and promoted (1825) to archdeacon. In 1839 he was made first bishop of Toronto. He made great success during his visitations which were an annual episode. He had more than doubled the number of churches in five years, also establishing common schools throughout the province and a statute was passed establishing 20 grammar schools affording classical education. He obtained 500,000 acres (1827) to endow a university at Toronto, and, after difficulties, succeeded in its foundation. In 1850 it was taken from the Anglican Church and made non-sectarian. Strachan made vehement appeals to the laity and, assisted by a royal charter, formed another university under the name Trinity College. He was Canada's greatest advocate of the Church of England, for which sect he gave business energy, diplomatic talent and a devoted zeal. Consult Bethune, 'Memoir of Bishop Strachan' (Toronto 1870); Mockridge, C. H., 'The Bishops of the Church of England in Canada and Newfoundland' (Toronto 1896).

STRACHEY, strā'chĭ, **John Saint Loe,** English journalist: b. 1860. He was educated at Oxford and has been a London journalist from 1884. He was editor of the *Cornhill Magazine* (1896–97) and is now editor and owner of *The Spectator* and proprietor of *The Country Gentleman.* He has published 'From Grave to Gay'; 'The Manufacture of Paupers' (1907); 'Problems and Perils of Socialism'; 'The Practical Wisdom of the Bible' (1908); 'A New Way of Life' (1909).

STRACHEY, William, English colonist and historian: b. England, about 1585. Nothing definite is known of him before the sailing of a party of colonists, 15 May 1609, bound for Virginia. He sailed in the *Sea Venture,* which was wrecked on the Bermudas in July. An account of the wreck was written by Strachey and published in 'Purchas his Pilgrimes' (1625) under the title 'A True Repertory of the Wracke and Redemption of Sir Thomas Gates upon and from the Islands of the Bermudas, his coming to Virginia and the state of that Colony.' Strachey and his party finally reached Jamestown, 23 May 1610, where he was appointed secretary and recorder of the colony by Lord De la Warr. He returned to England in 1611 and he edited the laws promulgated for Virginia by Sir Thomas Gates and Sir Thomas Dale, 'For the Colony in Virginia Britannia Lawes Divine, Morall and Martiall, Alget qui non ardet' (1612). His larger work on Virginia, 'The Historie of Travaile into Virginia Britannia, expressing the Cosmographie and Comodities of the Country, Together with the Manners and Customes of the People. Gathered and Observed As Well by those who went First Thither, As Collected by William Strachey, gent. Three Yeares thither Imployed Secretarie of State,' failed of finding a publisher during his lifetime and was brought out by the Hakluyt Society in 1849. This is regarded as the most ably written of the numerous accounts of the settlement of Virginia. Nothing is known of the history of Strachey subsequent to 1618 when he tried unsuccessfully to interest Bacon in the publication of his book. Consult Brown, Alexander, 'Genesis of the United States' (Boston 1891).

STRADELLA, Alessandro, Italian singer and composer: b. Naples, 1645; d. Genoa, 1681. After receiving his early musical training at Naples, he subsequently went to Venice, and thence to many other cities of Italy where he was greeted with enthusiasm. He was constantly threatened with death or injury by the rivals to whom his triumphant success was intolerable. While he fortunately escaped from the hands of his would-be assassins at Rome, he was severely wounded by bravos at Turin, and an attack made upon him at Genoa proved fatal. The most exquisite of his many compositions is the oratorio 'San Giovanni Battista.' Flotow's opera of 'Stradella' is concerned with the career of this composer. Consult Crawford, F. M., 'Stradella' (London 1911); Richard, P., 'Stradella et les Contarini' in the Paris musical journal 'Le Ménestrel' (1865, No. 51; 1886, No. 18).

STRADIVARI, strä-dē-vä'rē, **Antonio,** Italian violin-maker: b. Cremona, 1644; d. 1737. He was a pupil of Nicolo Amati, in whose employment he remained until about 1679, when he began making on his own account. It was he who settled the typical pattern of the Cremona violin, and his instruments for tone and finish have never yet been excelled. His improvements consisted chiefly in lowering the height of the arch of the belly, in making the four corner-blocks more massive, in giving greater curvature to the middle ribs, in altering the setting of the sound-holes, and in making the scroll more massive and prominent. He made a great number of violins, but a few of which are now in existence. He reached his greatest perfection in his art about 1714. He also made many other kinds of musical instruments, but it is on his violins of all kinds that his fame rests. Consult Hill, W. H., 'Antonio Stradivari' (New York 1909); Riechers, A., 'The Violin and the Art of its Construction' (London 1905).

STRAFFORD, străf'ŏrd, **Thomas Wentworth,** 1st Earl of, English statesman: b. London, 13 April 1593; d. by execution Tower Hill, 11 May 1641. Entered at Saint John's College, Cambridge, in 1607 he became a student of the Inner Temple, and in 1611 received the honor of knighthood. He was returned for Yorkshire to the Parliament which met 5 April 1614, and in 1621 he was again chosen. On the convening of the new Parliament he was one of the six popular members who were prevented serving their country in that assembly by being appointed sheriffs for their respective counties. When Charles, among other expedients for raising money, had recourse to a forced general loan, Wentworth refused to pay his contribution, and was first imprisoned in the Marshalsea. In 1628 he took his seat for Yorkshire, and became one of the most conspicuous advocates of the petition of right. In 1628 he was created Baron Wentworth, and some months afterward a viscount and privy-councillor, and on the resignation of Lord Scrope, nominated President of the North. The assassination of Buckingham soon after removed an obstacle to his further promotion, and he became so influential in the king's council that his powers in the four northern counties over which he presided were enormous. The legality of some of the powers of the Council of the North, created by Henry VIII, had been questioned by judges in the reign of Queen Elizabeth, and these powers had been greatly increased at the instance of Wentworth. He was selected by Laud to proceed to Ireland as lord-deputy in 1632. He greatly improved the state of the country, both as regarded law, revenue and trade. By a considerable outlay at his own risk he introduced the growth of flax, established looms, brought workmen from France and Flanders to work them, and thus endowed the country with a new and most valuable industry. But, at the same time, nothing could be more arbitrary than his system of government, it being his boast that he had rendered the king as absolute in Ireland "as any prince in the whole world could be." He returned with the full title of lord-lieutenant, with a view to gain subsidies and troops, in which he fully succeeded. He again repairing to England took the command in the north, but found himself obliged to retire before the Scottish army, and to retreat to York. The very first movement of the party opposed to arbitrary power was to impeach him for high treason, with which charge Pym appeared at the bar of the House of Lords in November 1640. The articles of impeachment, at first nine in number, were afterward increased to 28, the object of which was to convict him of an attempt to subvert the fundamental laws of the country. As in the case of Laud, it was easy to prove that he acted as a friend and promoter of arbitrary measures, but not to substantiate any particular fact to justify a capital charge. There can be no doubt, however, that his design was to subvert the fundamental laws and liberties of his country, and to enable the king to rule absolutely and without control. Although treated with the extreme of legal rigor and debarred the assistance of counsel, his own great abilities and force of mind supplied every deficiency. "And never man," says Whitelock, the chairman of the impeaching committee, "acted such a part, on such a theatre, with more wisdom, consistency, and eloquence, or with greater reason, judgment, and temper." His defense, indeed, was so strong that the original impeachment was deserted for the unjustifiable proceeding of a bill of attainder. The bill passed the Commons by a great majority, and was carried in the Lords by a feeble one. The king, who had imprudently endeavored to stop the bill by his personal interference, had not sufficient firmness to redeem the pledge of safety which he had previously given, but yielded to the advice of his counsellors, backed by a letter from Strafford himself, who urged him, for his own safety, to ratify the bill. Charles ratified the bill of attainder on 10 May 1641, and two days later Strafford was executed. Browning's ‘Strafford: An Historical Tragedy’ (1837), is based on his career. Consult Browning, Robert, ‘Prose Life of Strafford’ (Boston 1892); Firth, C. H., ‘Papers Relating to Thomas Wentworth, First Earl of Strafford’ (London 1890); Foster, ‘Statesmen of the Commonwealth’ (1836); Gardiner, S. R., ‘History of England’ (10 vols., New York 1883–84); Radcliffe, ‘The Earl of Strafford's Letters and Dispatches’ (London 1739); Traill, H. D., ‘Lord Strafford’ (London 1889).

STRAIGHT, Willard Dickerman, American consul-general and financier: b. Oswego, N. Y., 31 Jan. 1880. He studied at the Bordentown, N. J., Military Institute (1897) and was graduated (1901) at Cornell. He served (1902–04) in the Chinese Maritime Customs at Nanking and Peking, became American vice-consul-general and private secretary to American Minister at Seoul in 1905. From 1906–08 he was consul-general at Mukden. In 1909 he was appointed representative in China for a group of American bankers. In 1917 he was commissioned to the major-adjutant general's department United States Reserve.

STRAIGHT TICKET. See Ballot.

STRAIGHT COLLEGE, an educational institution in New Orleans, La., open to pupils of both sexes without regard to race or nationality. It was the pioneer school in Louisiana to provide education privileges for the negro race. It was founded in 1869 by the American Missionary Association (Congregational), and its first building was erected by the United States government. At first it offered only courses of elementary and secondary grades, but as the work steadily prospered higher departments were added. The organization now includes (1) the Daniel Hand Primary School; (2) the Grammar Department; (3) the College Preparatory Department; (4) the Industrial Department; (5) the Normal Department; (6) the College Department; (7) the Department of Music; (8) the Theological Department. There is also a night school. The College Department offers two courses, classical and Latin scientific, and confers the degrees of A.B. and B.S. The preparatory department provides two corresponding secondary courses. The normal course requires four years' study beyond the grammar grades. but the first year's course is identical with the first year of the College Preparatory Department. The Theological Department provides courses for those who are graduates in a classical course and for those who have had only English courses. There is, in addition, a course in Bible Study. Industrial training is given only in connection with the regular school work. The courses in the Industrial Department are Domestic science, sewing and dressmaking, wood-working, mechanical drawing and printing. The college has a central location; the buildings include the main edifice, replacing the former building destroyed by fire in 1891, Stone Hall, a dormitory for girls, and Whitin Hall, a dormitory for boys. The college depends partially for its support on the American Missionary Association. The tuition fees are small, and the older students are allowed to pay a part of their expenses by doing work. The average annual attendance of students is over 600. The teaching staff numbers 25.

STRAIN, Isaac G., American naval officer: b. Roxbury, Pa., 4 March 1821; d. Aspinwall, Colombia, 14 May 1857. He was appointed midshipman in the United States navy in 1837; in 1845 led an exploring expedition into the interior of Brazil and in 1849 made the overland journey from Valparaiso to Rio Janeiro. He received rank as lieutenant in 1850, was engaged in that year with the commission which laid out the boundary line between United States and Mexico, and in 1854 was in charge of the expedition for the survey of the Isthmus of Darien. The extreme hardships which his command was called upon to endure in this latter expedition and the skill and courage with which Strain met the difficulties that beset him brought him favorably before the public. He was assigned to the *Arctic* in 1856 and was engaged in making soundings in the North Altantic Ocean for the purpose of ascertaining the possibilities of laying a submarine cable between United States and Great Britain. He wrote ‘The Cordillera and Pampa’ (1853); ‘The History and Prospects of Interoceanic Communication’ (1856). Consult Headley, Joel Tyler, ‘Darien Exploring Expedition, Under Command of Lieutenant Isaac G. Strain, U. S. N.’ (1885).

STRAIT OF MAGELLAN. See Magellan, Strait of.

STRAITS SETTLEMENTS, East India, a British colony consisting of Singapore, Penang, Malacca and several isolated possessions on and adjacent to the Malay Peninsula, and bounded by the Federated Malay States. Singapore includes the island of that name, the Cocos (Keeling) Islands, and Christmas Island. The total area of the colony is 1,600 square miles, and the combined population about 762,000, the greater portion being divided between Chinese and Malays, only 7,945 being white. The colony is administered by a governor residing at Singapore, under whom are British resident councillors at Malacca and Penang. In 1867 the Straits Settlements' were transferred from the government of India to the colonial office. The colony has a large and important transit trade through Singapore and Georgetown. Among its exports are tin, spices, gambier, rubber, copra, gum, tapioca, coffee, pineapples, sago and rattan. It imports rice, cotton and cotton goods, coal, opium, tobacco, petroleum, flour, fish and dress goods. The ports of the colony are all free; the shipping amounts to over 27,000,000 tons, and the trade to about $497,000,000 annually. For further details see Penang; Singapore.

STRAKOSCH, strä'kŏsh, **Moritz,** Austrian pianist and impresario: b. Lemberg, Poland, 1825; d. Paris, 8 Oct. 1887. He was educated at Vienna, and came to the United States in 1845, where he was a teacher and a concert pianist. In 1856 he began opera and concert managing, and introduced to the public Patti, Nilsson, and other famous singers. He also composed several pianoforte pieces, and 'Giovanna di Napoli,' an opera; and wrote 'Memoirs of an Impresario.'

STRALSUND, strāl'soond, capital of the government of Pomerania, and seaport on Strela Sound, 120 miles northwest of Berlin. The town stands on a promontory and presents a picturesque appearance with its wooden-gabled, antique buildings. The town-house (1311) contains an interesting collection of ancient relics from the island of Rügen and several churches, government-house, gymnasium, mint, arsenal, a large public library and charitable institutions. The principal manufactures are leather, sugar, starch, machinery, arc lights, bricks, furniture, oil and cards. There is considerable trade carried on from the port. This consists principally of grain, sugar, fish and malt. Stralsund was founded in 1209 by Saxons. It joined the Hanse Confederation and early attained commercial importance. It has repeatedly suffered severely from war. Wallenstein besieged it without success in the Thirty Years' War (1628). In 1678 Frederick William, the great elector of Brandenburg, took it after a severe bombardment. Politically it was a Swedish possession from 1648 to 1815 when it was annexed to Prussia. Population about 35,000.

STRAMONIUM. See Datura.

STRANAHAN, străn'ā-ạn, **James Samuel Thomas,** American philanthropist: b. Peterboro, N. Y., 25 April 1808; d. Saratoga, N. Y., 3 Sept. 1898. He taught school for a year and then became a surveyor. In 1827 he went to the Northwest to trade with the Indians, but this venture proving a failure he reurned to Albany and entered the wool business. He founded the town of Florence, N. Y., in 1832 and in 1838 represented it in the assembly. In 1854 he was elected to Congress from Brooklyn to which he had removed in 1844. In 1860 he became park commissioner of Brooklyn. This office he held for 22 years, and during this time he controlled the expenditure of nearly $9,000,000 for improvements. A bronze statue of him was unveiled at the entrance to Prospect Park 1891. He was actively engaged in the consolidation of New York, Kings, Queens and Richmond counties into the present city of New York.

STRANG, străng, **Lewis Clinton,** American dramatic critic: b. Westfield, Mass., 4 Dec. 1869. He was graduated from the Boston University 1892. In 1894 he was assistant city editor and assistant in the dramatic department of the Boston *Journal* and in the fall of 1898 became dramatic editor. He has published 'Famous Actresses of the Day' (1899–1901); 'Famous Actors of the Day' (1899–1901); 'Prima Donnas and Soubrettes of Light Opera and Musical Comedy in America' (1900); 'Celebrated Comedians of Light Opera and Musical Comedy in America' (1900); 'Players and Plays of the Last Quarter Century' (1902).

STRANGE, strānj, Sir **Robert,** English engraver: b. in Pomona, one of the Orkney Isles, 14 July 1721; d. London, 5 July 1792. He studied law, attempted a seafaring life, then resolved to devote himself to painting. When the rebellion of 1745 broke out, he joined the forces of the Pretender and was present at the battle of Culloden. To conceal himself from pursuit he wandered for some time in the Highlands, and afterward ventured to Edinburgh, where he subsisted for some time by selling drawings which he had made of the chiefs of the rebellion. He afterward went to France, gained a prize for design at Rouen, and then resided for some time in Paris, where he studied engraving under Le Bas. In 1751 he settled in London, and became the founder of the English school of historical engraving. In 1760 he again visited the Continent and engraved pictures of many of the old masters. He was admitted member of the academies of Rome, Florence, Bologna, Parma and Paris, and on his return to England in 1787 was knighted. He followed the Italian masters, for the most part. His work is strong and individualistic; though it is sometimes defective in execution and especially drawing. Consult Blanc, Charles, 'L'Œuvre de Robert Strange' (Leipzig, 1848); Dennistoun, 'Memoirs of Sir Robert Strange' (London 1855).

STRANGE, Robert, American senator and lawyer: b. Virginia, 20 Sept. 1796; d. Fayetteville, N. C., 19 Feb. 1854. He was educated at Hampden-Sidney College and, after graduation, studied law and removed to Fayetteville, N. C. In 1821 he obtained election to house of commons and served till 1826, when he was elected judge of the Superior Court, from which he resigned to become member of the United States Senate. In 1840 he resigned in preference to carrying out the demands of his constituents. Returning to private practice he was appointed solicitor of the Fifth Judicial District. He wrote a novel, ‘Eoneguski; or the Cherokee Chief,’ which was based on Indian legends of the Fayetteville region.

STRANGLES, a disease of the horse, ass, and mule, affecting especially young animals. It generally appears between the third and fifth years, and is preceded by cough, with a yellowish discharge from the nostril, and a considerable discharge of ropy fluid from the mouth. This is accompanied by the formation of a tumor under the jaw, beginning about the centre of the channel, and gradually filling the whole space. The disease is sometimes mistaken for glanders, but is easily disinguished by the fact that there is only a single tumor. The tumor gradually swells in the centre, becoming softer until it bursts, when a discharge of pus takes place. The cough then subsides, and the disease rapidly abates, although a considerable time often elapses before the animal recovers its strength. During the progress of the disease the animal suffers considerably from thirst, which it is unable to satisfy by drinking freely, the attempt to swallow bringing on a convulsive cough, from which the disease has its name. Treatment is chiefly directed toward advancing the development of the tumor, on the bursting of which convalescence depends. This is most effectively done by blistering or fomentation. When the swelling becomes soft on the top it should be freely lanced. When it is allowed to burst naturally an ulcer is formed which is very difficult of treatment. Consult Hutyra and Marek. ‘Special Pathology and Therapeutics of the Disease of Domestic Animals’ (Chicago 1912); Pearson, L., and others, ‘Special Report on Diseases of the Horse’ (Washington 1911).

STRANGULATION, violent constriction of the neck, involving such compression of the windpipe as to close the air-passages, prevent respiration, and finally cause death. In hanging, which sometimes produces strangulation, if much violence is used, death may be caused by direct injury to the upper part of the spinal cord (q.v.) from fracture or dislocation of the cervical vertebræ, or by syncope from shock; in such cases death must be almost instantaneous. If the constriction is so applied as to compress the great vessels in the neck and not the windpipe, death is due to coma, and is somewhat slower than in cases of asphyxia. If both vessels and windpipe are compressed, coma and asphyxia may both contribute to cause death. When suspension of the body has not continued for much more than five minutes, and the parts about the neck have not suffered violence, there is a probability that resuscitation may be established; though many cases are recorded when after only a few minutes' suspension it has been found impossible to restore life. Moreover, if a person who has hanged himself has been cut down sufficiently soon to allow of the respiratory process being restored, he is by no means safe, death often taking place from secondary effects. It is believed that unconsciousness comes on very rapidly, and death takes place without causing any suffering; the violent convulsions that are so often observed being similar to those which occur in epilepsy. Exposure to a free current of air, cold affusion, if the skin is warm, the application of ammonia to the nostrils, of mustard poultices to the chest and legs, and of hot water to the feet, and the subsequent abstraction of blood if there should be much cerebral congestion, are good measures for the treatment of partial strangulation. They should be used if natural breathing is not at once resumed. From the post-mortem appearances together with circumstantial evidence, the medical practitioner is not unfrequently called upon to answer such medico-legal questions as: Was death caused by hanging, or was the body suspended after death? Was the strangulation the result of accident, homicide or suicide? In case of strangulation from other causes than that of hanging the post-mortem symptoms are similar, but the injury done to the parts about the neck is commonly greater. In manual strangulation the external marks of injury will be in front of the neck, about and below the larynx; and if death has been caused by a ligature the mark around the neck will be circular, whereas in hanging it is usually oblique. The internal appearances are much the same as in the case of hanging.

STRANGURY, an affection marked by scanty and painful micturition, with a frequent and irresistible desire to pass water. The urinary discharge is accompanied with scalding, cutting pains in the urethra, which sometimes extend to the bladder, the kidneys and the rectum. Strangury is a variety of retention of urine which may be caused by idiopathic urethrites, by gonorrhœa, or by such irritating substances as cantharides and oil of turpentine, or by gravel or calculus in the bladder. Besides removal of the cause, the following means are useful in treatment: The warm sitz-bath, or hot fomentations over the bladder; an injection of starch and tincture of opium, a wine-glassful of the former to a dram of the latter; and mild mucilaginous drinks of barley or rice water, which may be freely given to render the urine less irritating.

STRANSKY, Josef, American orchestral conductor: b. Humpoltz, Bohemia, 9 Sept. 1874. He was educated at the Prague Gymnasium and the universities of Prague, Vienna and Leipzig. He studied music under Judassohn, Fuchs and Bruckner. From 1897–1902 he was conductor at the Royal Opera at Prague, then at the Hamburg Opera and Symphony Concerts (1902–09). After directing operatic performances and concerts all over Europe he came to New York and has been conductor of the Philharmonic Society of New York since 1911.

STRAP-WORK, a style of architectural ornamentation or enrichment general in the 15th and 16th centuries and of which specimens exist executed as far back as the 11th century. It consists of a narrow fillet or band folded and crossed, and occasionally interlaced with another.

STRAPAROLA, strä'pạ-rō'lạ, **Giovanni Francesco,** Italian novelist: b. Caravaggio, Italy, end 15th century; d. Venice, about 1557. His life is enveloped in doubt in spite of much research, but he wrote ‘Canzoniere’ which were edited in 1508 at Venice, besides a number of novels from popular traditions published under the title ‘Piacevoli Notti’ (‘Facetious Nights’) at Venice in 1550. The work has been reprinted. The Fairy Tales are the first work of the kind in Italy's prose literature and it has proved the well from which many later writers have drawn their inspiration. From him are derived our 'Puss in Boots,' 'Fair Star,' 'Fortunio,' etc. Consult Rua, G., 'Le Piacevoli Notii'di F. Straparola recherche' (Turin 1898); Borromi, C. 'M. G. F. Straparola da Caravagio' (Pavia 1899).

STRAPPADO, a former military punishment, which consisted in having the hands of the offender tied behind his back, drawing him up by them to a certain elevation by a rope, and then suddenly letting him drop to within a certain distance of the ground.

STRASSBURG, Gottfried of. See GOTTFRIED OF STRASSBURG; and TRISTAN UND ISOLDE.

STRASSBURG, sträs'boorg, France, capital of Alsace-Lorraine, on the Ill, two miles west of the Rhine, on the French frontier, 350 miles southeast of Paris. It is ranked as a fortress of the first class. A massive inner rampart and 14 modern forts defend the city. It is cut by the Ill into several sections, and bears a quaint mediæval aspect. It is divided into four cantons; and owing to the fact that through it in normal times passes most of the traffic between France, Germany and Switzerland, from the Strassburg side, the city is of very considerable commercial importance.

The minster or cathedral, the product of four centuries (10th to 14th), is one of the grandest Gothic churches of the Continent. The tall spire (466 feet) rises from the western front, which is richly embellished with statues and bas-reliefs. The screen of double tracery is the work of Steinbach (13th century). The majestic interior is also richly decorated, and of vast dimensions. In the south transept stands a wonderful astronomical clock (14th century), renovated in 1839–42. It includes a perpetual calendar; the relative position and movements of the planets forming the solar system and many automatic figures which act at stated intervals. Other interesting features of the minster are the beautiful stained glass and rose-window (42 feet wide); choir-frescoes; and a pulpit of 1485. The Emperor William University (16th century) received a new foundation from the German emperor in 1872, the institution having been closed during the German occupation of Strassburg in 1870. It includes six faculties, has 172 teachers and an attendance of about 2,200 students. The library, which is one of the largest university collections in Germany, contains about 1,000,000 volumes, and 12,000 manuscripts. The main façade faces the imperial palace. Beyond the principal buildings are the various institutes for the exact sciences, the observatory, etc. Others are for the study of experimental physiology, pathology, pharmacy, surgery, eye-clinic, etc. The town also contains several good churches, Hotel-du-commerce, governor's palace, town-house, assembly-room, various museums and collections, benevolent institutions, excellent hospitals and a very large railway station.

Numerous public squares are embellished by statues, fountains and historical monuments, including busts of Goethe, Gutenberg and others.

The burgomaster, six associates and a council of 36 members constitute the governing body of the city. The most famous industry is the making of *pâtés-de-foie-gras* (fat liver pies) whose annual export has sometimes reached $500,000. Other industries comprise tobacco, liquor, leather goods, clothing, furniture, carpets, machinery, musical and surgical instruments, artificial flowers, gloves and the products of foundries, locomotive works, tobacco factories, tanneries, chemical works and piano factories. Transportation facilities by land and water are excellent. The town has always occupied an important military position and has been defended by fortifications of great strength and magnitude. Celts were the first inhabitants, replaced by Romans, and subsequently by Teutons, and about the 6th century Strassburg became a Frankish possession. This was the commencement of its German connection. Bishops and citizens were in perpetual strife in the early history of the town and the citizens finally obtained their independence (14th century). In 1681 it was seized by Louis XIV and became a province of France. In 1870 it was besieged and captured by the Germans and was ceded with Alsace and Lorraine to Germany. By the Peace Treaty of 1919 it again came under French control.

The population, which is about equally divided between Protestants and Roman Catholics, is 180,000. Consult Enting, Julius, 'Descriptive Guide to the City of Strassburg' (Strassburg 1905); Signouret, Raymond, 'Souvenirs du bombardement et de la capitulation de Strassburg . . . 1870' (Bayonne 1872).

STRATEGY, the science of directing, with promptitude, precision and clearness, masses of troops to gain possession of points of importance in military operations. Its object is to so direct these masses that upon reaching any designated point, the army shall have a better position than that held by the enemy, or shall have such a position as will force him to change his position, or shall be superior to him in numbers, or shall have some decided advantage over the enemy, in case of a conflict. In general, it may be divided into peace and war strategy, and the latter can be subdivided into that in the area of hostilities and that at home, comprising the mobilization, etc., of units and resources to support the forces at the front. There are two main principles which guide all warfare, whether on land or sea, and these are concentration and the initiative. *Concentration* consists in so disposing the forces that they may be superior to the enemy at the critical point and moment. A belligerent secures the *initiative* when he compels the enemy to conform to his movements, to accept battle on his own terms, and that means when his concentration is completed. The value of the initiative is that it enables the belligerent securing it to take advantage of concentration, and *strategy* is the art by which a belligerent brings about this condition of affairs. The initiative must not be confounded with the offensive, they are not synonymous terms.

There is a close relationship between strategy and tactics. Strategy is, in a peculiar sense, the science of generals in command of armies; while tactics in all its ramifications, from the elementary drill of the soldier to orders of battle, from the bivouac of an outpost to the encampment of an army, now belongs to officers of all grades. Yet with these marked differences, it is sheer pedantry to pretend to define the precise limits of these two prominent branches of the military art, as they present a multitude of exceptions in which they approach and run into each other. Tactics, if we restrict its meaning to the evolutions and manœuvres of troops on the field of battle, may be taught with mathematical exactness, because every movement is accurately prescribed, and the more so the lower we descend the scale of this branch of military knowledge. But this is far from being true of strategy, because in the calculations involved in its operations, a great many considerations enter which do not admit of exact computation, and upon which success or failure essentially depend; as time, the character of the roads over which the army has to move, the nature of the obstacles which lie between it and the enemy, the moral qualities and activity of the enemy's forces, etc.

In a mountainous country, the strategical points, although few in number, are generally very prominent. The junction of several valleys, or roads along the crests of several ridges, would naturally be of great value to an army occupying it, as the forces might operate in any one of the valleys or along any of the roads with an equal facility, while the enemy, once committed to one line, could not change to another without great labor and loss of time, necessitated by the retrograde movement resulting from the difficulty of crossing the intervening spurs or valleys. In the campaign of 1796-97, in Italy, Bonaparte, by causing the redoubt which closed the pass of the Montenotte to be occupied by 1,200 men, was able to interpose his army between the armies of the allies — Austrians and Sardinians — and whip them in detail. At this time the allies, numbering about 60,000 men, were operating in three columns by three roads separated by very difficult mountainous country. Bonaparte, with about 30,000 men, holding the middle road, the pass of the Montenotte, very successfully accomplished his plan of attacking in succession the columns of the enemy. The campaign was thus decided from its inception, and the redoubt of Montenotte, seconded by a small and brave garrison had great influence upon the final result. The capital city of a country is usually a very important strategical point. This may proceed, not from its influence on the military operations of a campaign or from its position, but from the fact that it is the seat of the government the occupation of which by the enemy may have a lasting and damaging effect in a political point of view. During the American Civil War great importance was attached to the capture of the city of Richmond, and all the campaigns of the army of the Potomac were made with that city as the objective point, with the idea that its fall would put an end to the war. This was undoubtedly too much to expect, for the bulwark of the rebellion was not the city of Richmond, but the Confederate armies, and their capture or overwhelming defeat was necessary before the fall of the city would be a decisive cause of the close of the war. The supplies and reinforcements of the Confederate army were nearly all drawn from the States south of Virginia, and as long as the avenues of supply remained intact the cohesion of the army was assured and it remained a menacing force.

Movements in war, whether offensive or defensive, must always be based on calculation of time and distance. In an offensive war the operations are vaster, the conditions more variable and the elements of the calculation more uncertain. In a military point of view, the offensive has its good and its bad side. Strategically an invasion leads to deep lines of operation, which are always dangerous in a hostile country. All the obstacles in the enemy's country, the mountains, rivers, defiles and forts, are favorable for defense; while the inhabitants and authorities of the country, so far from being the instruments of the invading army, are generally hostile. However, if success be obtained, the enemy is struck in a vital point; he is deprived of his resources and compelled to seek a speedy termination of the contest. For a single operation, which we call taking the *initiative*, the offensive is almost always advantageous, particularly in strategy. Indeed, if the art of war consists in throwing the masses upon the decisive points, to do this it will be necessary to take the initiative. The attacking party knows what he is doing and what he desires to do; he leads his masses to the point where he desires to strike. Tactically, the *offensive* also possesses advantages, but they are less positive since, the operations being upon a limited field, the party taking the initiative cannot hide them from the enemy, who may detect his designs, and by the aid of good reserves cause them to fail. Whatever advantages may be expected either politically or strategically from the offensive, it may not be possible to maintain it exclusively throughout the war; for a campaign offensive in the beginning may become defensive before it ends. The offensive confers, at the outset, the power of concentrating on the flank or centre of the enemy's line of defense, and so turning or breaking it. The defender must either oppose the enemy with an inferior force at first, or abandon territory in order to assemble his forces at some point further back. On the other hand, offensive war demands great resources, and success itself, if not absolute and decisive, entails fresh difficulties on the invader. And when he has penetrated very far within the defender's territory, the situations of the antagonists differ greatly, inasmuch as the army on the offensive is bound to its base, be that base wide or narrow, while the defensive forces may base themselves on any portion of the territory which will supply them and which their front protects. It is evident that when one belligerent power feels secure behind an unassailable frontier, and holds many issues into the enemy's territory, either by command of the sea or otherwise, it can assemble its forces unknown to its antagonists upon some point selected by itself, from whence to make an eruption into the theatre of war. And if the belligerents be divided only by a frontier line — a river such as the Rhine, or a mountain range such as the Alps — the army that passes it will nearly always find itself immensely superior to the forces that can immediately interpose.

Battles have been stated by some writers to be the chief and deciding features of war. This assertion is not strictly true, as armies have been destroyed by strategic operations without the occurrence of pitched battles, by a succession of inconsiderable affairs. It is also true that a complete and decided victory may give rise to results of the same character when there have been no grand strategic combinations. The results of a battle generally depend upon a union of causes which are not always within the scope of the military art; the nature of the order of battle adopted, the great or less wisdom displayed in the plan of the battle, as well as the manner of carrying out its details, the more or less loyal and enlightened co-operation of the officers subordinate to the commander-in-chief, the cause of the contest, the proportions and quality of the troops, their greater or less enthusiasm, superiority on one side or the other in artillery or cavalry, and the manner of handling these arms; but it is the *morale* of armies, as well as of nations, more than anything else, which makes victories and their results decisive. When the march of an army has been so conducted, that, when it meets the enemy on the field of battle, it has a decided advantage over him, the battle which follows will usually be more decisive than in the contrary case. A single battle well fought under the foregoing condition has frequently been decisive of the whole campaign, and even of the war. The battle of Jena gave Napoleon advantages, which vigorously followed up in the manner so peculiar to him, soon placed the kingdom of Prussia at his feet, and left him free to turn his attention to the Russians.

Tactical and strategical consideration both enter into the problem of determining the point of attack; the consideration which will govern in any particular case will depend upon the results which are expected to follow the defeat of the enemy, or the risks to be run in attaining these results. The tactical considerations relate to the advantages which can be gained on the field of battle; and the strategical to the consequences of victory. The strategical conditions are more important than the tactical, unless the difficulties of the ground are too great, and the results expected to follow do not justify the risks to be taken. Let the army *P* in Fig. 1, find the enemy in the position *A B*, with one flank resting on a hill and the other on a river, with an impossible marsh in front. The point *A* is both the strategical and tactical point of attack; for its capture would command the field of battle, force the enemy from his line of retreat, *x y*, and throw him back on the impassable obstacle opposite the left flank, *A C;* with the right reinforced it would be a better position for the assailed to take, as in this case an attack at *A* would compel the assailant to fight with an obstacle at his back, and an attack at *C* would give the assailed the full benefit of the height. The position *A C* is also objectionable, as it presents a salient *D*, always a weak point in a line, because it renders both faces liable to be enfiladed. Suppose an army, acting on the defensive, to have the position *X Y*, Fig. 2; its right uncovered, and its left resting on an impassable obstacle. The strategical point of attack is *Y*; for, if the left is forced back, the line of retreat *A B* is exposed. But the selection of *Y* as the point of attack forces the assailant to fight with his back to the obstacle *Z*, which would be very dangerous unless greatly superior to the enemy. Rather *X* select as the point of attack, and depend upon vigorous fighting and pursuit for great results. Combined attacks, like combined marches, cannot be relied upon for success. They should only be undertaken when the natural features of the country are such that the enemy can be easily checked if he attempts to make a counter-attack, and when the preliminary movements of the troops are concealed from his view. When the features of the country are such that the detachments can, by taking up naturally strong positions, hold the enemy in check, the main body can operate with safety against the flank; for, in case of repulse, its main line of retreat would not be compromised. Much depends upon the character of the opposing general; if he be alert and always ready to act promptly and vigorously, any extended movements would be dangerous, although it might under other circumstances be successfully carried out. Movements may be made with troops that are superior in numbers or in discipline, which would be very rash when the opposing forces are nearly equal, or the commanders of the same capacity. A careful reconnaissance is important in both tactical and strategical operations. A general reconnaissance has for its object the obtaining of detailed and accurate information of countries and their armies that will be of assistance in case of war. It comprises within its scope our own as well as other countries, for the data obtained may be useful in prosecuting military studies, and as an aid to a general in drawing up his plan of operations, which includes the

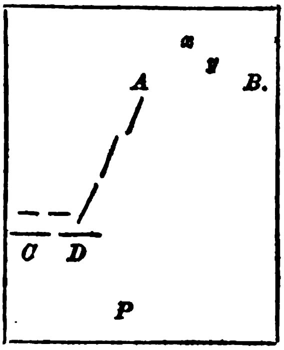


FIG. 1.

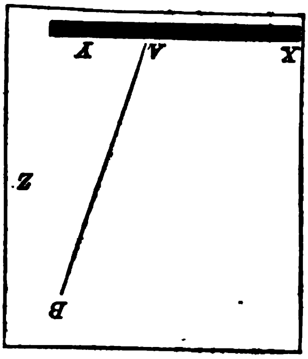


FIG. 2.

movements of troops necessary for concentration as well as their employment after this has been accomplished and they are ready to meet the enemy. Tables of statistics, giving population, manufactures, industries and information concerning the roads, railroads, canals, rivers, important improvements, etc.; geographies, general and military; reports of various kinds, etc., will all be found of great assistance in compiling the required information. But, however complete and exhaustive these sources of information may be, officers of the army should frequently be sent to different countries to examine and report not only upon their military systems, but upon any subject which may become important in a military point of view. This method not only serves to retain possession of much that might be of great utility in planning military operations, but it enables officers to gain personal experience of peoples and their customs, which might be invaluable to them and to their country, in the event of war. *Special* reconnaissances are made with reference to the actual military situation at the time, and a report of them is usually made at once, frequently upon the spot. They are known as *topographical* and *armed* reconnaissances, the latter being usually termed a *patrol, scout,* or *secret reconnaissance.* A reconnaissance in force is generally made just before a battle, for the purpose of forcing the enemy to develop his strength and dispositions.

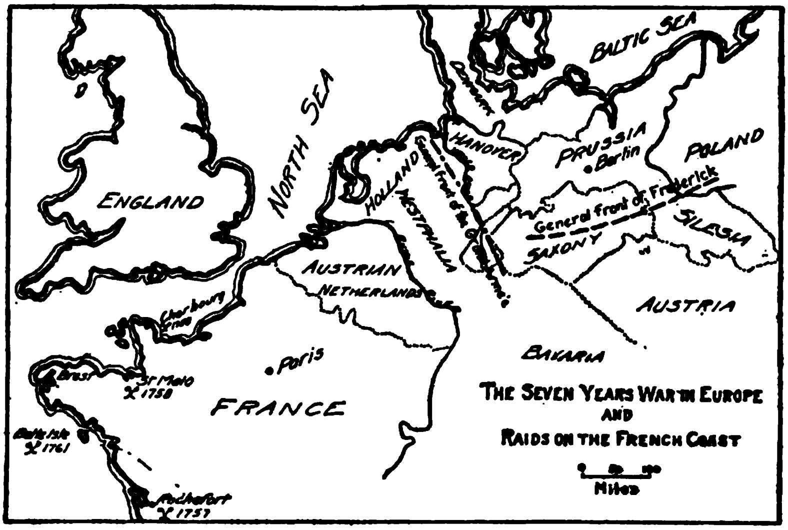


FIG. 3.—Illustrating the value of Land-and-Sea Operations and combined expeditions directed against the Sea-power of the enemy.

The addition of infantry gives to reconnoitering parties a strength and power of resistance which cavalry can never attain by itself. The employment of artillery tends toward a similar end and the especial mobility of horse artillery renders it most appropriate for such service. Artillery is nevertheless seldom added to an ordinary reconnoitering party, its use being generally confined to a reconnaissance in force, or a special reconnaissance. But, although guns are not much employed upon this kind of duty, there may still be occasions where artillery would prove a useful addition to the other arms, as by its assistance, woods or other suspicious places, within range, could be effectively examined or cleared of the enemy's presence, without the necessity of a close approach. Guns can also cause the withdrawal of parties of the enemy from small defensive positions by acting on their flank.

From the point of view of most recent military strategy, America's greatest contribution to the successful outcome of the European War was the hotly-contested battle of the Meuse, which resulted in cutting the main artery of the German supply system. Up to the middle of September 1918 the Germans were able to operate unmolested the Sedan-Mezières railway running parallel to the front and furnishing a base of supply for the whole line from Valenciennes to Metz. To cut this supply line at both ends and force withdrawal or capture on this entire front the British attacked in the north. The first few days of fighting yielded considerable gains. Fully conscious of the gravity of the situation, the enemy threw in division after division of fresh troops, and during the ensuing weeks occurred the bitterest fighting in which American troops took part. The second week of October practically all available units — about 28 divisions — were in the line. Progress could be made only a few yards at a time, but the continued hammering finally wore out the resistance of the enemy forces and the American troops broke through. Day after day steady gains were made up the west bank of the Meuse, until, on 7 November, the United States forces entered the outskirts of Sedan and definitely cut the German supply line. A day later the French forces came up on the left flank. The meeting of French and American troops on this historic spot signalized the defeat of the German arms, a defeat as decisive and humiliating as that forced upon France 47 years before at the same spot. If there had been questions before as to the acceptance of the armistice terms, the allied advance culminating in this meeting at Sedan left no choice in the matter. In the final campaign of the war American troops thus played a part in a triumph which was beyond all praise.

The actual success of operations in war must primarily rest on the action of small bodies; good previous strategical movements, a correct formation of the order of battle, a proper selection of the points to be attacked, will make the success when obtained of far greater importance; but the actual success must ultimately depend on the correct handling of small bodies of men. This is one of the features of modern fighting and one which must be carefully considered. A battle under existing circumstances is a series of small battles or fights in which bodies of troops, perhaps not greater than a brigade, are engaged, and each of these bodies must be tactically complete, must work for one object, and seek to carry one point. It has been said that for the future no direct attack can possibly be made on troops occupying a position and that attacks must be made on the flanks: but recent experience shows that attacks on the flanks, unless supported by a strong front attack, can always be met and defeated. The strategy of the recent European War was largely influenced by the enormous frontages successfully held. Relying on the defensive power of modern weapons, great extensions of lines were made for the purpose of resting flanks on secure obstacles. When a line is persistently and sufficiently battered, a retirement becomes necessary. This is depressing to the morale of the troops and even in a voluntary retirement the losses in men and matériel are unduly large. Therefore, a retirement should be avoided when possible and should be accompanied by a contraction of the front, either closing in on the centre leaving two exposed flanks, or to one side leaving one exposed flank. It would appear that whatever advantage accrues from shortening the front would accrue equally to both sides. The advantage of a short front lies in the fact that it takes a greater preponderance of force to break a front strongly held than one weakly held. Further, the opportunity for manœuvre is restricted by a narrow front. Wellington's withdrawal to the lines of Torres Vedras is a classical example of shortening front by retirement. The European War furnished one example of the successful shortening of a line in the Allied withdrawal to the Salonika position.

Numerous wars have demonstrated the strategical principles of concentration of effort, importance of initiative, value of surprise and necessity for unrelenting pressure on a beaten enemy, and they have been demonstrated again in the European War. But operations of detached forces against the enemy's communications, of which there are many examples in former wars, seldom occurred in the late war. Such operations depend on rapid and resolute execution and close co-operation between the divided forces. Operations against communications are hardly practicable under modern war conditions with the huge forces and continuous fronts involved. General Maude used this method against the Turks at Kut el Amara, but it was not used in the great theatres in Europe.

The attack at Gallipoli can hardly be classed as an operation against communications, although undertaken partly with the object of cutting off the Turks from their German allies. The operations demonstrated the futility of employing inadequate forces, for the French and British gained no advantage from this employment of a dozen divisions assisted by naval forces. The operations of the German submarines were aimed at the British sea communications. The Allies could not get at the German fleet because of mine fields and coast defenses and the submarines caused the employment of considerable naval forces against them. It is thus advantageous to menace the enemy's communications.

The European War may be termed a *war of positions*. The French and German armies, after marching toward one another, came into collision. The French army, led away by warlike enthusiasm, threw itself without protection against the cannon, the machine guns and the trenches of the German army; and left thousands of dead on the first battlefields. It retreated. At the Marne it offered a superb resistance, once more sacrificing thousands of lives. Then the German army retreated in its turn, but established itself solidly on the Aisne, protected by previously prepared trenches. The French army dug in opposite. Each adversary, finding himself unable to dislodge the other by direct assault, tried to outflank him. Thereupon began the famous "race to the sea"; the two armies stretched out trenches, face to face with one another, all the way between two impassable obstacles, the sea and Switzerland. The European War, much more than any preceding war, may be termed a war of *matériel*. An offensive, even a partial one, requires not only an enormous supply of cannon, munitions and machines, but also factories capable of producing them, railroads and highways sufficient for their circulation, ships, cars and trucks in plenty to bring them up and special depots for their storage. The European War may also be termed a war of *attrition*. In previous wars professional soldiers fought with their own resources and settled between them the quarrels of nations. To-day it is the nations themselves, with all their forces, human and material, that take part in the struggle; they fight till one of the adversaries is completely exhausted. Thus, attrition, which applies to both men and *matériel*, is a factor which is bound to enter largely into final results. Attrition in men is irreparable; attrition in *matériel* can be offset by greater activity in the factories, but these factories must be sufficiently well equipped to meet the needs of the army under all circumstances. Attrition in men is not very dangerous for countries which have sufficient human reserves, such as Russia, nor yet for those like France and Great Britain, which can draw on their colonies. On the other hand, it is highly dangerous for countries like those of Central Europe, where human resources are strictly limited. For these countries there will inevitably come a moment when it will be impossible to find enough men to hold the front and to run the factories.

During the European War numerous actions and things occurred to change the significance attached in certain quarters to the word *strategy*. Its meaning may be better grasped if illustrated, rather than defined. Hamley, a well-known English writer, claims that "the theatre of war is the province of strategy, the field of battle is the province of tactics." Clausewitz considered that "tactics is the employment of troops for the object of the fight; strategy is the adaptation of fighting for the object of the war." Derrécagaix, a French author, observed that "the combinations of strategy are governed by immutable principles, while tactics includes operations which are subject to modification as improvements are made in war material." This, however, does not furnish the whole truth, as certain principles of tactics, such as concentration of force, the value of surprise and of superiority of fire, are as constant as those of strategy. At the commencement of the European War, the word strategy at once attained high popularity, while the word tactics was neglected. Strategy, then, soon came to be the term applied to every operation of war, large and small. A reconnoitering patrol which had carried out its duties smartly was said to have displayed fine strategy, the clever concealment of a machine gun was cunning strategy, etc., etc. Mont Kemmel, a small hill in French Flanders, became a strategical key point, and it has been stated on the highest authority that Vimy Ridge, which was captured in 1917, has proved to be a feature of the highest strategic importance. Formerly tactical would have been the adjective used in these descriptions, now it is strategical.

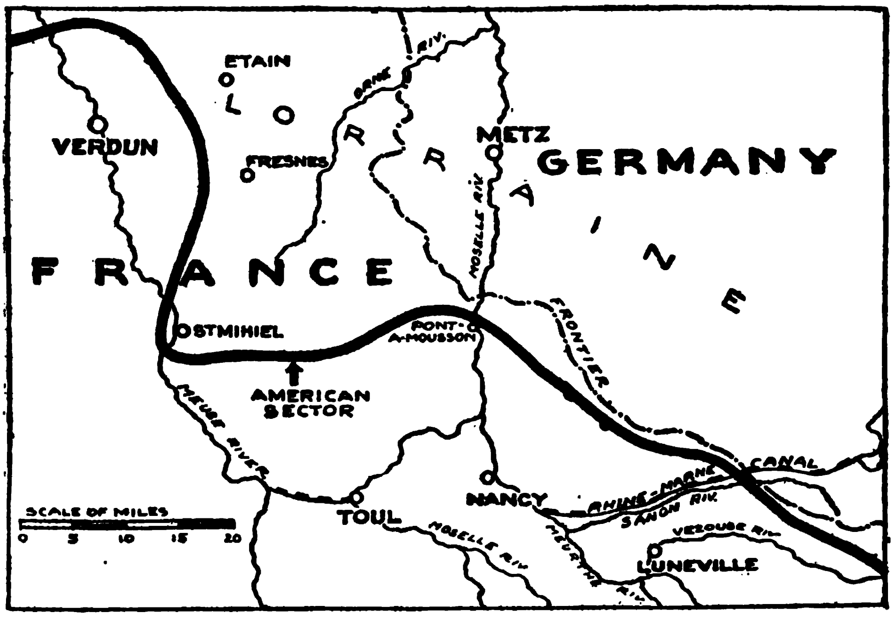


FIG. 4.—The American Sector and Strategic Movements near the Boundary dividing French from German Lorraine.

In the course of the European War, 1914–18, there developed many strategic mysteries — the Russian success in East Prussia, followed by the defeat at Tannenberg; the sudden arrest and defeat of the Germans on the Marne; Mackensen's overwhelming blow against the Russians when the latter were threatening to overrun Hungary in the early part of 1915; and many others. The easiest of these strategic mysteries to explain is the final and rapid rout of Bulgaria. This was due to the reinforcement of the Allies by Venizelo's new Greek army, though this army was not used on the part of the field where the chief rupture was effected. Contributing causes were the deterioration of the *morale* of the Bulgarian army and people and the skill with which General D'Espérey chose the time and place for the chief attack. The Allied intelligence was thorough in its functions. (See Fig. 4.).

Considering the great advances in aeronautics, radio-telegraphy and gunnery it is apparent that the true way to security is *strategic surprise*, that is to say, it is possible for the enemy to attack when we are least prepared to cope with him and by the skilful use of *inner lines*. The British in the Northwest were very efficiently assisted by the French to keep up their priceless communications with their sea bases and held back for months hundreds of thousands of the invaders and at last the converging Entente armies, in November, 1918, brought about the completest collapse of Germany since the days of Julius Cæsar. (Fig. 4). Profiting by a study of the blunders of 1870, we may add to Napoleon's maxims about readiness these two principles: (a) In strategy, as in everything else, the jump into the unknown is the reverse of desirable, or reasonably one has no right to substitute for the hard facts of reality, which should always be sought for, the creations of imagination and hypothesis. On these known facts alone a reasonable operation can be based. (b) In any case, not merely in strategy, but in fact, one ought not to undertake a manœuvre which causes dispersion without being guaranteed the possibility of being able in time and place to change it into a concentrated plan.

Another lesson enforced on all students of war alike by Napoleon, Moltke and Foch is that knowledge, a disciplined understanding, a cultivated memory and all the resources of science, art, invention, as well as readiness, judgment and initiative are more important to the general than to surgeons, engineers, etc. The strategist of to-day declares that ignorance and carelessness are intolerable in military men and that military skill is priceless. The mind is the army. The general is the soul, the nerve centre, the brains of the army. (See Tactics). Consult Altham, ‘The Principles of War’ (London 1914); Aston, ‘Sea, Land and Air Strategy’ (ib. 1914); Clausewitz, ‘Germany's War Mania’ (ib. 1914); Derrecagaix, ‘Modern War’ (Washington 1890); Dufour, ‘Strategy and Tactics’ (New York 1864); Dickman, ‘Notes on the German Army’ (United States Infantry and Cavalry School, Fort Leavenworth 1897); Mahan, ‘Mahan on Naval Warfare’ (Boston 1918); Wagner, ‘Organization and Tactics’ (London 1895).

Edward S. Farrow,
Consulting Military and Civil Engineer.

STRATEMEYER, străt'ĕ-mī-ėr, **Edward**, «Capt. Ralph Bonehill,» «Arthur M. Winfield,» American writer of juvenile fiction: b. Elizabeth, N. J., 4 Oct. 1862. He was editor of *Good News, Young People of America,* and *Bright Days.* He has published over 100 volumes, including ‘Old Glory Series’ (1898–1902); ‘Dave Porter Series’ (1905–16); ‘Flag and Frontier Series’ (1899–1907); ‘Rover Boys Series’ (1899–1917); ‘American Boys Life of William McKinley’ (1901); ‘American Boys Life of Theodore Roosevelt’ (1904); ‘Putnam Hall Series’ (1905–12).

STRATFORD, Canada, city and county-seat of Perth County, Ontario, on the Avon River, and on the Grand Trunk Railway system; 88 miles west-southwest of Toronto, and 80 miles northeast of Sarnia. The chief industrial establishments are the railway repair shops, saw, planing, flour and woolen mills, foundries, and manufactories of chairs, carriages, bricks, shoes, biscuits and confectionery, cigars and machinery. There are five banks. The city contains a general hospital, house of refuge, boys' home, numerous churches, a public library, city hall and courthouse. For educational purposes there are the Provincial Normal School and several public and separate schools. Stratford was first settled in 1831, became a borough in 1855, and was incorporated as a city in 1885. Its government is vested in a mayor and a council of 10 aldermen elected annually. Pop. about 20,000.

STRATFORD, Conn., city in Stratford township, Fairfield County, on the west bank of the Housatonic River, about two miles from its mouth, and on the New York, New Haven and Hartford Railroad. It is three miles from Bridgeport and is bounded on the south by the Long Island Sound. Its manufactures consist of paints, silverware, brassware, etc.

STRATFORD DE RADCLIFFE. See Canning, Stratford.

STRATFORD-UPON-AVON, ā'vŏn, England, a market-town and municipal borough in Warwickshire, 94 miles northwest of London, on the Avon. The town comprises an old and a new section, but its chief points of interest are associated with the name and life of Shakespeare. In Henley street stands an unpretentious one-story gabled wooden house, where he was born, and which now belongs to the British government. The house where he died was torn down in 1759. The parish church of Holy Trinity, late Gothic, dates from the 15th century, and Shakespeare's remains were interred in its chancel. There stands to-day a monument and bust erected to his memory.

Anne Hathaway also is buried in this church. A small memorial hall and the interior of the town-hall are dedicated to Shakespeare's memory. The town has a fine guild-hall, a new public library, rich in Shakespeareana (1905), art gallery with many Shakespearean paintings, market-house, corn exchange, almshouses, churches for Dissenting denominations, a hospital for infectious diseases, a new school for technical education, public schools, the fine Shakespeare memorial theatre, and the Shakespeare fountain, erected by George W. Childs, the well-known American. The town-hall contains Garrick's portrait by Gainsborough. At Wilmcote near by is the cottage of his mother and at Shottery, also in the neighborhood, that of his wife, Anne Hathaway. The visitors to the town are its chief source of wealth. The tercentenary of Shakespeare's death was celebrated with great *éclat* in 1916. In recent years, through the efforts of Marie Corelli, and a few who support her artistic tastes great changes have been wrought in the ancient town. Old houses with plastered walls, which were eyesores to the visitors and residents alike, have been stripped of their outward ugliness, to reveal the quaint, picturesque tudor architecture of Shakespeare's time. Wherever it has been possible the early appearance of the buildings has been restored, and the effect has been a most remarkable transformation and restoration of the place as Shakespeare knew it. The ancient «sword of state,» which hangs in Shakespeare's birthplace, was removed from its scabbard in August 1914, as an official notice that England was at war. The people say tradition forbids them to sheathe the old sword carried by Shakespeare's father when he was high bailiff in 1568–69, until England is again at peace. The town owns the gas and water-works, and has constructed an excellent system of main drainage and works for sewage disposal. Pop. 8,531. Consult Lee, Sir Sidney, ‘Stratford-on-Avon’ (London 1890); Savage, ‘The Registers of Stratford-on-Avon’ (ib. 1898); Stopes, C. C., ‘Shakespeare's Environment’ (ib. 1915).

STRATHCONA, Canada, a town of Alberta, Northwest Territories, on the south bank of the north Saskatchewan River, opposite Edmonton, with which it is connected by a steel bridge. It is the northern terminus of the Calgary and Edmonton branch of the Canadian Pacific Railway, and with Edmonton (q.v.), it is the transportation centre for the grain, cattle, and other industries of northern Alberta. There are in the town some manufactures, among them flour, oatmeal, butter and cheese, lumber, foundry products, boats and dredges. Coal is mined in the vicinity. Strathcona has churches, schools, banks and weekly newspapers. Pop. about 8,000.

STRATHCONA AND MOUNT ROYAL, Donald Alexander Smith, 1st Baron, Canadian statesman: b. Forres, Morayshire, Scotland, 1820; d. 1914. After education in the preparatory schools of his native country, he went to Canada in the employ of the Hudson's Bay Company in 1838, where he spent 13 years on the Labrador coast, after which he was stationed in the great Northwest, where he was promoted to be a chief factor. Later he was named resident governor and chief commissioner of the company in Canada. He first became prominent in public life when appointed special commissioner by the Dominion government to investigate the insurrection under Louis Riel in 1869 at the Red River settlement. In 1870 he was elected to the Manitoba legislature as member for Winnipeg on the organization of that province, and later on to the Canadian House of Commons for Selkirk. But owing to the passage of a law against dual representation he resigned from the local house in 1874. He was also appointed a member of the Northwest Territorial Council. In 1880 he lost his seat in the Canadian House. He re-entered public life in 1887, as a member of the Dominion House, remaining there till 1896, when he was appointed to represent the Dominion of Canada in London as High Commissioner, a position he held until his death. At the beginning of his political career he supported Sir John Macdonald, the conservative leader; but at the time of the «Pacific Scandal» in 1873, he transferred his support to the Liberals. After 1878 he gave Macdonald independent support in his fiscal and railway policy. He was actively connected with many industrial and commercial undertakings, but his name is particularly connected with railway development in Canada. The organization and success of the Canadian Pacific Railway is due largely to him. In 1886 he was knighted and in 1897 raised to the peerage as Baron Strathcona and Mount Royal, and he was the recipient of many other favors and honors, among them degrees from a dozen universities. He was president of the Bank of Montreal (1887), governor of Fraser Institute, and governor and chancellor of McGill University (1898) and of the University of Aberdeen (1903) and also Lord Rector of the latter institution. He was prominently connected with a long list of educational, religious and financial institutions. Lord Strathcona was a very liberal and appreciative patron of art and his art collection is said to have been the largest and most varied possessed by any one person in Canada. His benefactions to education were extensive and widely distributed. He endowed the Royal Victoria College, Montreal, for the higher education of women; gave over $1,000,000 to McGill University; about the same amount to the Royal Victoria Hospital, Montreal; and he endowed chairs in numerous colleges. He gave $1,000,000 to the King Edward Hospital fund and was a liberal helper of other similar institutions.

STRATHROY, Canada, town and outport of Ontario, County of Middlesex, on the River Sydendam and on the Grand Trunk Railroad. It is 20 miles west of London and has a collegiate institute and armory, a cannery, brewery and manufactures of iron castings, stoves, etc. Pop. 2,823.

STRATIFICATION, layering in sedimentary rocks. Such layering is usually produced by changes in the character of the sediments being deposited. These may be changes in the composition of the material, as when a clay is laid down on top of a sand; or they may be changes in the size of particles, as when a fine sand is covered by coarse sand. A cross section of any sand bar along a creek bed will illustrate the process. On a small scale it is produced by daily or seasonal variations in the carrying power of a stream or streams. On a larger scale in the ocean it is produced by depression or uplift, so that areas near shore which received coarse material such as sand are brought out into the deeper water and receive fine muds or oozes, and the reverse. Sometimes, after a layer of material has been deposited, there is an interval during which the material partly solidifies before the next layer is formed. This will produce a plane of parting or bedding plane. See Formation; Stratum, etc.

STRATIGRAPHY, that branch of geology that deals with the arrangement, age and succession of rock strata, mainly as revealed by the contained fossils. See Geology, section devoted to *Stratigraphy*.

STRATTON, străt'n, **Charles Sherwood** («Tom Thumb»), American dwarf: b. Bridgeport, Conn., 4 Jan. 1838; d. Middleborough, Mass., 15 July 1883. He was born of normal parents, and showed no peculiarity until the age of seven months, when he ceased to grow in height. In 1842 he was taken by his mother to P. T. Barnum, and at that time was 28 inches in height, and weighed a little more than 15 pounds, though he later increased in size. He was perfectly proportioned, active and intelligent; and his exhibitions proved a great success. In 1854 he was taken to England by Barnum and presented to the queen and royal family, and later to Paris, everywhere receiving marked attentions. In 1863 he was married to Lavinia Warren, a dwarf girl, and together they traveled widely and gave exhibitions.

STRATUM, a unit of classification in the scale of geological formations. It is a section of any geological series, composed throughout of the same material as shale, limestone, sandstone, coal, etc. The stratum may be subdivided into beds of which there may be many in a thick stratum. Beds, where very thin, are known as laminæ, and the sediments are said to be laminated. A stratum indicates a uniform condition of decomposition during its formation.

STRAUS, strows, **Isidor,** American merchant and communal worker: b. Rhenish Bavaria, 6 Feb. 1845; d. with his wife in the Titanic disaster, 1912. He arrived in America in his ninth year and settled in Tolbolton, Ga., and was preparing to enter the West Point Academy, when the Civil War intervened. In 1865 he removed to New York, where his father founded the firm of L. Straus and Sons a year later. In 1888 he and his brother Nathan associated themselves with R. H. Macy and Company of New York, and in 1893 with Abraham and Straus of Brooklyn. Always interested in tariff and currency reform, he was elected 3 Jan. 1894 from the 15th District, New York, to fill the unexpired term of A. P. Fitch to Congress. He was president of ‘The Educational Alliance’ and a prominent worker in charitable and educational movements, and was very much interested in civil service reform and the general extension of education. He declined the portfolio of Postmaster-General which was offered him by President Cleveland.

STRAUS, Nathan, American merchant and philanthropist: b. Rhenish Bavaria, 31 Jan. 1848, brother of Oscar Solomon and Isidor Straus (qq.v.) He came to the United States in 1854 with his family who settled in Tolbolton, Ga., where he attended school. He afterward went to New York and graduated at Packard's Business College. He joined his father in the firm of L. Straus and Sons, importing pottery and glassware; from 1888 was partner in R. H. Macy and Company, New York; from 1892 of Abraham and Straus, Brooklyn, and retired in 1914 to devote his time to charity. In 1898, during the Spanish-American War, he donated an ice plant to Santiago. He originated, in 1890, and has since maintained at his own expense, a system of distribution of pasteurized milk to poor of New York City, which, statistics of health department show, is saving many thousands of lives annually. He also originated and maintained a system of depots for distribution of coal to poor of New York in winter; and in the panic of the winter 1893–94, maintained a system of lodging houses for poor and homeless. He was appointed by President Taft sole United States delegate to the International Congress for Protection of Infants, Berlin, 1911, also delegate to the Tuberculosis Congress, Rome, Italy, 1912. In 1912 he established soup kitchens in Jerusalem for relief of destitute, and a health bureau for the elimination of conditions causing malaria, in Palestine. During winter of 1914–15 served for the unemployed 1,135,731 penny meals from his milk depots in New York City, was chief contributor in sending a food ship to war sufferers in Palestine, and extended his Jerusalem health bureau to care for sick and wounded, under auspices of the Palestine government. He has delivered numerous addresses on pasteurization and published ‘Disease in Milk, the Remedy, Pasteurization’ (1913).

STRAUS, Oscar Solomon, American merchant and diplomat, brother of Isidor and Nathan Straus (qq.v.); b. Otterberg, Bavaria, 23 Dec. 1850. A resident of Georgia from 1854 to 1865, he was graduated from Columbia University in 1871 and from its law school in 1873. He engaged in mercantile life for a time with his father's firm, but found leisure for literary and educational work. He was appointed United States Minister to Turkey 1887–98 and 1898–1900, in 1902, a member of the Permanent Count of International Arbitration at The Hague and in 1906 he became Secretary of Commerce and Labor in the Roosevelt Cabinet. He was Ambassador to Turkey (1909–10); and Progressive candidate for governor of New York State; and he arbitrated the dispute between the engineers and managers of the eastern railroads (1914). The following year he became chairman of the public service commission of New York State.. He is president of the American Jewish Historical Society and has published ‘The Origin of Republican Form of Government of the United States’ (1886); ‘Roger Williams’ (1894); ‘The Development of Religious Liberty in the United States’ (1896); ‘Reform in the Consular Service’ (1897); ‘United States Doctrine of Citizenship’ (1901); ‘Our Diplomacy with Reference to our Foreign Service’ (1902); ‘The American Spirit’ (1913).

STRAUSS, David Friedrich, German theologian: b. Ludwigsburg, Württemberg, 27 Jan. 1808; d. there, 8 Feb. 1874. He studied in Tübingen University; became assistant to a country clergyman in 1830; was appointed temporary professor in the seminary at Maulbronn; resigned this position and went to Berlin in 1831 to study under Schleiermacher and Hegel. He returned to Tübingen and lectured on logic and philosophy; and published in 1835 his famous ‘Life of Jesus,’ in which he attempted to prove that the gospel narratives had a mythical origin and growth. To his numerous critics he replied in ‘Streitschriften’ and ‘Zwei friedliche Blätter.’ Appointed in 1839 to the chair of dogmatic theology in Zürich he was prevented from entering upon his duties by a storm of popular indignation, but received a small pension in recompense. In 1848 he was elected a member of the Württemberg Diet; a position he resigned because he found it uncongenial. His subsequent writings were ‘Christliche Glaubenslehre’ (1839–41); ‘Life of Schubart’ (1849); ‘Life of Christian Märklin’ (1851); ‘Life of Ulrich von Hutten’ (1858–60); ‘Leben Jesu für das Deutsche Volk’ (‘Life of Jesus for the German People,’ 1877); ‘Der Christus des Glaubens und der Jesus der Geschichte’ (‘The Christ of Faith and the Jesus of History,’ 1865), and ‘Der alte und der neue Glaube’ (‘The Old and the New Faith,’ 1872), in which he defines his final attitude to Christianity, that being now entirely hostile. His more important works have been translated into English. He also gave much attention to literary criticism and wrote critical biographies of Schubart.

STRAUSS, Eduard, Austrian composer of dance music, son of Johann Strauss: b. 1835; d. Vienna, 29 Dec. 1916. He was the composer of more than 200 pieces of dance music, being almost as prolific a composer as his famous father, who wrote 246 pieces of dance music and innumerable operettas. His brother Joseph, known as the «Waltz King,» was the composer of nearly 300 waltz pieces. In 1870 Eduard Strauss became prominent in the musical world when he was made conductor of the court balls in Saint Petersburg. Later he made many tours with his own orchestra throughout Europe and in 1892 and 1901–02 visited America. He made his home in Vienna, where in the summer he played at the Volksgarden and in the winter at the Gesellschaft der Musikfreunde.

STRAUSS, Emil, German novelist: b. Pforzheim, 31 Jan. 1866. He attended gymnasia at Pforzheim, Mannheim, Karlsruhe and Cologne and the universities of Freiburg, Lausanne and Berlin. At Freiburg, where his studies were in philosophy, literature and political economy, he formed a close friendship with Emil Gött (1864–1908), with whom he settled successively in various country places in order that they might live the life of common peasants together (Ueberlingen, Emmisheim, Kappelrode). He is at present living at Hellerau, a suburb of Dresden. His favorite pursuit in literature is the detailed study of childhood and adolescence, resulting in the production of a number of fine psychological studies, of which the best are ‘Der Engelwirt, eine Schwabengeschichte’ (Berlin 1900; 4th ed., 1910) and ‘Freund Hein, eine Lebensgeschichte’ (Berlin 1902; 20th ed., 1912). Other works are ‘Kreuzungen’ (novel; Berlin 1904); ‘Hochzeit’ (drama; Berlin 1908); ‘Hans und Grete,’ (short stories; Berlin 1909); ‘Der nackte Mann’ an historical novel (Berlin 1912). A translation of his short story, ‘Mara,’ is given in ‘German Classics’ (Vol. XIX, New York 1914).

STRAUSS, Johann, Austrian composer of dance music: b. Vienna, 14 March 1804; d. there, 25 Sept. 1849. He was violinist and assistant conductor in Lanner's orchestra; and in 1824 organized an orchestra of his own, with which he made a number of tours, going to England in 1838. In 1845 he was appointed to conduct the court balls at Vienna. His musical compositions, mostly waltzes, number about 250. They raised the standard of dance music to a high artistic level. Among the waltzes are ‘Lorelei’; ‘Gabrielen’; ‘Victoria’; ‘Bajaderen’; ‘Taglioni’; ‘Kettenbrucken’, and ‘Donau Lieder.’ Consult Lange, F. J., ‘Lanner and Johann Strauss’ (Vienna 1914).

STRAUSS, Johann, German composer, son of the preceding: b. Vienna, 25 Oct. 1825; d. there, 3 June 1899. Though his father strongly opposed his musical aspirations he became conductor of an orchestra in a popular restaurant, after the death of his father uniting the latter's and his own orchestras. He conducted the summer concerts in Petropaulooski Park in Saint Petersburg 1855–66, and the court balls 1863–70 and made tours throughout Europe. ‘The Beautiful Blue Danube’ is the most celebrated of more than 500 waltzes composed by him, of which many others gained great popularity. He also composed successful operettas, including ‘The Carnival in Rome’ (1871); ‘Indigo’ (1871); ‘Die Fledermaus’ (1874); ‘Cagliostro’ (1875); ‘Prinz Methuselem’ (1877); ‘Das Spitzentuch der Königen’ (1880); ‘Der lustige Krieg’ (1881); ‘Eine Nacht in Venedig’ (1883); ‘Der Zigeunerbaron’ (1885); ‘Simplicius’ (1887); ‘Ritter Pasman’ (1892); ‘Fürstin Ninetta’ (1893); ‘Jabuka oder das Apfelfest’ (1894); ‘Waldmeister’ (1895); ‘Die Götten der Vernunft’ (1897); ‘Aschenbrodel’ (ballet, 1897). Consult Eisenberg, L., ‘Johann Strauss’ (Leipzig 1912); Prochazka, R. Von, ‘Johann Strauss’ (Berlin 1900).

STRAUSS, Joseph, American naval officer and inventor: b. Mount Morris, N. Y., 16 Nov. 1861. He was graduated from the United States Naval Academy in 1885, and was engaged in hydrographic surveys on the east and west coasts of the United States and in Alaska 1887–90. He spent three years in the bureau of ordnance, Navy Department in 1893–96, and here invented the superposed turret system of mounting guns on battleships. He was then in charge of the United States Naval Proving Ground at Indian Head 1900–03. The powder factory was completed during the first year of this service and its operation begun. His next cruise was as navigator and executive officer on the monitor *Arkansas.* He was again ordered to the proving ground for two years as inspector in charge; was next executive officer on the *Montana* during a period of one year, after which he was in command of the *Montgomery,* conducting experiments with torpedoes. In 1910–12 he was assistant aid for material, Navy Department. He was a member of the commission to determine the cause of the sinking of the *Maine.* October 1912 he was ordered to command the battleship *Ohio;* October 1913, he became chief of the bureau of ordnance, Navy Department. He was promoted rear-admiral in 1918.

STRAUSS, Richard, German musician and composer: b. Munich, 11 June 1864. He studied music at Munich, was made court musical director there in 1886, and became court kapellmeister successively at Weimar (1889), Munich (1895) and Berlin (1898), with the Royal Opera. He has made extensive concert tours of Europe and he visited the United States in 1904. Strauss is one of the most successful song writers and composers of music therefor in the German language. He is one of the great masters of orchestration; and he has done much to improve program music. Much of his work is weak in invention but his wonderful technical skill is always in evidence. In addition to songs and chamber-music, he published a symphony (1884); a fantasy for orchestra, ‘Aus Italien’ (1886); the «symphonic poems» ‘Don Juan’ (1889); ‘Tod und Verklarung’ (1890); ‘Macbeth’ (1891); ‘Till Eulenspiegels Lustige Streiche’ (1894); ‘Sprach Sarathustra’ (1896); ‘Don Quixote’ (1898); ‘Ein Heldenleben’ (1899); ‘Sinfonia Domestica’ (1904); ‘Salome’ (1905); ‘Elektra’ (1909); ‘Der Rosen Kavalier’ (1911); ‘Ariadne auf Naxos’ (1912); ‘Josefliegende’ (1914); ‘Alpen-Symphonie’ (1915); ‘Festliches Praeludiuni’ (for orchestra); ‘Enoch Arden’; ‘Das Schloss Am Meer’; ‘Taillefer’; ‘Deutsche Motette’; ‘Bardengesang.’ Consult Bie, O., ‘Die moderne Musik und Richard Strauss’ (Berlin 1906); Henderson, W. J., ‘Modern Musical Drift’ (New York 1904); Huneker, J. G., ‘Mezzotints in Modern Music’ (1899); ‘Overtures’ (New York 1904); Newman, E., ‘Richard Strauss’ (London 1908); Schmitz, E., ‘R. Strauss als Musick-dramatiker’ (Munich 1907); Steinitzer, M., ‘Richard Strauss’ (Berlin 1914); Symons, Arthur, ‘Studies in Seven Arts’ (New York 1906); Urban, E., ‘Richard Strauss’ (Berlin 1901); ‘Strauss contra Wagner’. (Berlin 1902); Weingartner, Felix, ‘Post-Beethoven Symphonists’ (New York 1906).

STRAW MANUFACTURE. The use of straw in manufacture is varied and extensive. Besides its use in the making of paper it is woven into hats, baskets, bottle covers and saddles. Straw hats were first made and worn by the Romans, but the industry did not receive any impetus until about the 16th century, when Mary, Queen of Scots, engaged a number of straw-plaiters of Lorraine to return with her to Scotland to instruct her people in their art. The principal sources from which the United States imports straw are Italy, China, England, Switzerland, Japan, Belgium and France. It is estimated that in Saxony and Bohemia there are from 20,000 to 30,000 persons engaged in straw manufacture. The finest straws and braids are imported from Tuscany, where a fine grade of straw is produced, from which the delicate Leghorn braid is made. Some of the braids are so fine, and the work so trying on the eyes and nerves, that a person cannot work steadily at it more than an hour or two at a time. The Panama hat, though often classed as straw, is in reality made from young leaves of a certain kind of pine (*Corludovica palmata*). Straw has become one of the most important materials employed in the making of cardboard and coarse paper. Straw is sometimes used with other materials in the making of better grades of paper. Straw boards are the cheapest paper board on the market. Of these about 200,000 are manufactured annually. See PAPER.

STRAWBERRY, a perennial herb of the genus *Fragaria* (order *Rosaceæ*). The species are natives of the north temperate zone and of the Andes region of South America. They are exceedingly variable, botanists having described about 130 species, which are considered only forms of about 12 species; and even these are reduced by Bentham and Hooker to only four or perhaps three. The number of hybrids — crosses and varieties — is enormous and actively changing annually, as new varieties are introduced into cultivation and inferior ones are discarded. In the United States alone there are probably 1,000 varieties offered for sale each year, and half that number are occasionally tested in a single season at some of the experiment stations. The cultivated strawberries are derived from four species which are characterized by palmate, trifoliate leaves produced upon very short stems often less than an inch long and usually called a crown. The white or yellow, perfect or pistillate, flowers are borne in corymb-like racemes upon scapes which arise from the axils of the leaves. The pistils develop into small hard akenes, «seeds,» persistent upon the enlarged pulpy, edible receptacle, the «berry,» which in some varieties is white, but in the majority red. In Europe the hautbois strawberry (*F. moschata*) is somewhat cultivated for its dull red berries which are noted for their musky odor. They are seldom grown in America. Another European species, *F. vesca*, the alpine or perpetual strawberry, is also cultivated abroad, where its high quality and continuous bearing have rendered it popular in private gardens for which places it should be, but is not, very popular in America. The scarlet or Virginian strawberry (*F. virginiana*) is a native of eastern North America, where it is the common wild strawberry. It has been cultivated to some extent, but is more or less blended with other species, especially the following. The Chilean strawberry (*F. chiloensis*) is a native of the Pacific Coast of South America, with large, dark red, firm, fragrant fruits, which through its botanical variety, *F. chiloenses*, var. *ananassa*, the pine or common garden strawberry, is the parent of the vast majority of horticultural varieties cultivated in America if not throughout the world. This species was introduced into cultivation early in the 18th century.

The first successful American variety, the Hovey seedling, was introduced in 1834 or 1835, up to which time the European varieties had been cultivated in gardens. But not until 1854, when the Wilson or Wilson's Albany was introduced, can strawberry growing be said to have gained a footing upon a commercial scale. This firm-fleshed, large-berried variety quickly proved itself adaptable to a great variety of soils throughout the whole country, and its wonderful productivity led to its extensive planting. The growth of the industry has been so rapid and has reached such proportions that one writer asserts that probably more strawberries are shipped into New York in a day during the busy season than appeared in its markets during its history up to 1840. Commencing in Florida and the Mississippi Delta during February or earlier the strawberry «season» travels northward to Canada where it closes in July. And during this «season,» which lasts usually from two to three weeks in a locality, there are often trainloads of berries sent to market each day. In some of the more important regions such as the coastal plain of North Carolina, the Chesapeake Peninsula and western New York, the rate often reaches a carload a day for each mile of railroad through the shipping district. The berries are mostly used as dessert, but immense quantities are used for canning and for making jams and jellies. Various beverages and fruit syrups are also made from them.

Strawberries are propagated by means of seeds, division of the crown and by runners. New varieties are almost invariably grown from seeds, no two of which from the same fruit can be reasonably expected to produce plants identical as to vigor, productivity, season of maturity, etc., and among which if taken from ordinarily good fruits the proportion of valuable new varieties is probably less than one in 10,000. With seeds produced by hand-pollination of individual blossoms, and under the most careful management, the proportion may be one in 1,000 seedlings. All or almost all of the improved varieties have been produced in this way, only a very few being obtained by selection of individual plants, though this method is really operative more or less unconsciously in all plantations. Division of the crown is very rarely practised with American varieties but is more common with European. It consists in cutting the old plants apart so as to have roots with each part; after management is about the same as for runners. Very few of the strawberry plants grown in America are grown by other methods than by runners, which are produced freely by most varieties and will become independent plants usually within three or four weeks if covered with earth. When rooted they may be dug, trimmed and planted, care being taken to place the crown level with the surface of the ground. Sometimes they are rooted in pots for planting in autumn. In such cases they may be allowed to fruit the following season, and are usually allowed to bear two crops before being turned under, since they are more costly, and since the ground is generally cleaner by this method of management than by the common one. Sometimes the runners are dug in the spring, planted closely in nursery beds for a month, during which the soil is thoroughly worked to get rid of weeds and make it fine, and the plants which have developed numerous roots set preferably just before a shower.

Strawberries will succeed well upon almost any soil except the sandiest and the undrained mucky soils. They thrive best, however, upon rich sandy loam well drained but moist rather than dry. These may be anywhere in the United States or Canada where corn will mature and even in some places where the season is too short or the nights too cold for that. They should not be planted upon low ground, since in such places the blossoms are frequently destroyed by late spring frost unless expensive precautionary measures are taken. High land from which the cold air will readily descend, and upon which the flowers may open somewhat later, especially if the exposure be to the north, should be given the preference. If the soil has been in sod for several years it should be planted to corn or potatoes for at least two years to permit the ground to be brought into perfect condition and to allow the larvæ of various root-feeding insects a chance to escape, otherwise they, being deprived of their natural food, may injure the strawberry plants. During these two years liberal applications of stable manure should be given and the ground made as free from weeds as possible by thorough cultivation. If a crop of early potatoes be grown they may usually be harvested in time to allow autumn planting and except for harrowing, the land may not need further preparation. Usually, however, spring planting is preferred, the ground being plowed as deeply as practicable without turning up the subsoil. It is then harrowed and marked off in rows about 30 inches apart and the plants set by hand or, upon a large scale, by transplanting machines. During the first season most growers destroy the blossoms because it is considered that fruit bearing this season stunts the growth and impairs fruitfulness during the succeeding year. Since the plants are low growing and unable to fight weeds and also produce well clean cultivation is essential throughout the growing period. After the fruiting season runners will appear (often they come earlier) and should be allowed to root so as to form a more or less continuous row which by the end of the autumn should be about 18 inches wide. Some growers who supply fancy markets or special customers grow the plants in «hills» or «stools,» the runners being destroyed and the original plant encouraged to develop additional crowns. As soon as the ground freezes a mulch of marsh hay, straw, pine needles or other material free from weed seeds, is spread liberally upon the plants to keep the frost in the soil and prevent heaving of the plants and the consequent breakage of the roots. In the spring this mulch is either removed entirely from the field or is raked between the rows. In the former case one or two cultivations are usually given; in the latter, none. Either at this time or during the previous summer, or at both times, applications of commercial fertilizers may be made, the kinds and amounts depending upon the grower's idea of the needs of the plants and the richness of the soil. Wood ashes, muriate or sulphate of potash, dried blood, ground bone and superphosphates are favorite fertilizers. Nitrate of soda and sulphate of ammonia must be given with caution since they may tend to an abundant growth of foliage at the expense of fruitfulness. If, however, the leaves are yellowish, one of these should be given as a rule. When the berries have become fully colored they are gathered with the stems on and shipped to market in crates containing 24, 32 or 36 quart boxes. A yield of 200 bushels per acre is not uncommon and more than double that is often obtained by the most careful growers in favorable years. As soon as the crop has been gathered the plants are plowed under and the land planted to such crops as cabbage, turnips, beets or other plants that require only a short season to reach maturity. Sometimes if the land is exceptionally clean, when the crop has been light, or where the plants are especially vigorous, they may be allowed to remain for two seasons; the second crop, however, is usually lighter than the first and the beds are likely to become weedy even under best management. A favorite rotation is corn, potatoes, strawberries, cabbage, and grass and clover used for hay one or two years or pastured for several.

Strawberries are occasionally forced in greenhouses to supply a small demand among the wealthy. The plants are usually grown in pots because they can be better controlled than in benches and because they may be sold for decorative purposes as well as for dessert. They are generally potted in early spring and the first runners from them rooted in small pots which when full of roots are discarded for large pots in which these plants are to bear fruit. The pots are then kept in deep beds of ashes, preferably under a cold frame in which great care is directed to watering, especially toward and during autumn when it is gradually withheld, the plants even being allowed almost to wilt, in order to shorten up their growth and to store reserve food. After freezing, the plants may be removed as desired to the greenhouse, at first to low temperatures and later to higher ones in imitation of spring. In about eight weeks the fruit should be ready, but all through great care must be exercised in management, especially as to humidity of the air, ventilation, and pollination of the flowers, an operation that must be done by hand with a camel's hair brush, preferably.

Under the best management strawberries are seldom seriously injured by insects, although a considerable number are partial to this plant. The larvæ of several root-feeding beetles are sometimes troublesome, if the grower plants his strawberries upon a freshly turned sod. But this may be obviated by two or perhaps even one intervening crop of potatoes or corn. There are also several beetles which enjoy the blossoms, tender foliage or fruits, but since these travel slowly they may be avoided by selecting new ground each year. There are a few general feeding insects such as caterpillars, plant bugs, etc., which occasionally vary their diet with strawberries, but they are rarely troublesome. Several so-called plant diseases have been reported as causing losses in plantations, but very frequently the cause may be readily traced to other sources, such as planting in unsuitable soil, or upon lowlying land, by insufficient vigor of plant, due to lack of plant food, etc., but especially to continued use of the land for this one crop. All the above may be avoided by proper rotation, the strawberry being allowed to occupy the land only one year or in exceptional cases two years, and the ground being thoroughly cleaned by cultivation and judicious rotation before strawberries are again planted upon it.

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STRAWBERRY BASS, one of the many local names in the Mississippi Valley of a large and handsome sun-fish (*Pomoxis sparoides*), closely related to and resembling the crappie, but having the mottlings a clearer green and tending more to become spottings. It reaches a length of 12 inches, is a favorite game fish for young anglers, is good food and is abundant in clear cold streams and ponds. Other names are calico bass, grass bass and bar-fish.

STRAWBERRY BUSH. See Spindle Tree.

STRAWBERRY SHRUB, a shrub (*Calycanthus floridus*) native to the southern United States, which is widely cultivated for its flowers. These are dark purple, terminating leafy branches, with many series of imbricated strap-like sepals and petals. When crushed they give out a delicious aromatic fragrance which has been likened to that of strawberries or of fermenting wine. The receptacles are hollow and enclose the pistils; at maturity the receptacles enlarge (the bases of sepals, petals and bracts still adhering) into an urn-shaped capsule holding the true fruits or achenes. The leaves are ovate, rough above and pubescent beneath, and, together with the twigs, have an odor of cloves. Western species of the genus have like aromatic foliage and flowers, but *C. fertilis* bears inodorous blossoms.

STRAWBOARD, the name of a very thick, coarse cardboard, made of straw after it has been boiled in lime and soda to soften its texture. It is one of the products of paper mills and is manufactured by machinery similar to that used in such mills. The cheaper grades of strawboard are largely utilized in making boxes. The finer qualities are utilized in making book covers.

STREAK, in mineralogy, is the essential color of a mineral, or the color of its powder. It is most commonly obtained by rubbing the specimen on a tablet of rough white porcelain or on a piece of white hornstone. Any method may be employed which makes it possible to see the powdered mineral. It is a property of first importance in all schemes for the determination of minerals by their physical properties and is of especial value in differentiating the metallic minerals, whose external colors are often identical while their streaks may be very different. The greenish-black streak of chalcopyrite instantly distinguishes it from gold whose streak is like its external color. The red or reddish-brown streak of hematite serves to identify it when compared with the ochre-yellow or rust-brown streak of limonite, or the black of magnetite.

STREAM LINES. In the flow of fluids (including gases and liquids), the path described by any infinitesimal portion, or particle, of the fluid is called a stream line. The theory of stream lines is a part of the mathematical science of hydrokinetics. The most important result of this theory is known as the principle of Bernoulli (Daniel). It asserts that in the steady motion of liquids (or fluids of constant density) the sum of the pressure, the kinetic energy per unit volume and the potential energy per unit volume of the liquid, is constant along a stream line. The principle holds also, with a slight modification of statement, for the case of gases. This principle accounts for the fact that in the steady flow of liquids through tubes of variable cross section the pressure is least where the velocity of the liquid is greatest and vice versa, supposing the potential energy per unit volume of the liquid unchanged. It explains also the action of the Venturi water meter, the aspirator, the ball-nozzle contrivance and other mechanical devices. Consult Appel, 'Traité de Mécanique Rationelle'; Lamb, 'Hydrodynamics.'

STREAM PIRACY. Streams which are favorably located can cut down their channels and extend their tributaries faster than less favored streams. This is particularly true of those that are located in areas of softer rocks where less energy is required to erode. Such streams often extend their headwaters so rapidly that they encroach upon the less favorably located rivers and capture portions of their drainage. The former stream is said to behead the latter and the process is called stream piracy. In the Appalachian region, where many of the larger streams occupy parallel valleys on softer rocks, those streams which flow across the harder rocks are often beheaded by the larger rivers on the softer beds. The old valley notch across the hard ridge, which constituted a water gap, becomes abandoned and is then called a wind gap. See Trellised Drainage.

STREAM TIN, the name applied to cassiterite when it occurs in the form of sand or small pebbles in the beds of streams or in adjacent bottom lands. Owing to the great hardness, density and insolubility of cassiterite, it is readily concentrated by running water, and accumulates in extensive deposits, thus constituting an important source of supply of tin ore. It is largely worked in Australia, Tasmania, the East Indies, and formerly in Cornwall, England. See Cassiterite.

STREATOR, Ill., the largest city in La Salle County, on the Vermilion River, and on the Atchison, Topeka and Santa Fe, the Chicago, Burlington and Quincy, the Chicago and Alton, the Wabash, the New York Central, the Chicago, Ottawa and Peoria railroads, 90 miles southwest of Chicago. The city was developed as a coal-mining centre, mining commencing about 1868. The city was incorporated in 1882. It lies in the fertile agricultural region known as the northern Illinois corn belt, and is underlaid with coal and shale. The manufacturing establishments include glass and bottle factories, brick, drain tile and sewer pipe works, automobile factories, automobile accessory works, agricultural implements, washing machines, windmills, acetylene plants, foundries, detinning factory, etc. The latest census of manufactures reported 60 manufacturing establishments employing 1,918 persons, of whom 1,770 were wage-earners. The capital invested in these establishments was $6,993,000, annual amount of salaries, $150,000; wages, $1,045,000; the cost of materials, $1,762,000, and the value of products, $3,887,000. The trade is chiefly in manufacturing, coal, grain, livestock and dairy products. The principal buildings are the Federal building, municipal buildings, opera houses, hotels, Y. M. C. A. building, City Club, Elks' building, Masonic Temple, public library, Saint Mary's Hospital and about 25 large well-equipped churches. The educational institutions are a large high school, well-equipped public schools, parish schools, a kindergarten, private commercial schools, library and Y. M. C. A. reading rooms. The three national banks have a combined capital of $300,000. There are four thriving building and loan associations, and a large number of fraternal societies, lodges and organizations. Pop. 16,500.

STREET, Alfred Billings, American nature poet: b. Poughkeepsie, N. Y., 18 Dec. 1811; d. Albany, N. Y., 2 June 1881. From 1848 until his death he was State librarian of New York. Though diffuse, his verse displays a love of nature founded upon close and accurate observation and scarcely deserved the neglect into which it has fallen. His published works include 'The Burning of Schenectady and Other Poems' (1842); 'Drawings and Tintings' (1844); 'Fugitive Poems' (1846); 'Frontenac' (1849); 'Woods and Waters' a volume of Adirondack travel (1860); 'Forest Pictures in the Adirondacks,' poems (1865); 'The Indian Pass' (1869); 'Lake and Mountain' (1870); 'Eagle Pine' (1871).

STREET, George Edmund, English architect: b. Essex, 20 June 1824; d. 18 Dec. 1881. He was educated in Mitcham and Camberwell and received part of his professional training under Sir G. G. Scott, and like him held the Gothic style in highest favor, the numerous lectures and papers which he wrote on architecture being all directed to illustrate the history and principles, and promote the progress of that style. His principal literary works are 'The Brick and Marble Architecture of North Italy in the Middle Ages' (1885); and 'Some Account of Gothic Architecture in Spain' (1865). He was for many years engaged in the work of erecting and restoring churches and other ecclesiastical buildings. In this connection he designed Cuddesden Theological College, the Crimean Memorial Church at Constantinople. Saint Paul's (American) Church at Rome, the Law-Courts at London and various other churches in Oxford, Liverpool and other parts of England. He was also one of the most successful of church restorers, among his restorations being the cathedrals at York, Bristol and Carlisle and various noted chapels. In 1868 he was appointed architect of the new Courts of Justice in the Strand, London, after a competition in which were engaged the most famous architects of the day. This gigantic undertaking was not quite completed at his death. In 1866 he was elected an Associate of the Royal Academy and in 1871 became a Royal Academician. In the last year of his life he was appointed professor of architecture at the Royal Academy. Among his published works are 'The Brick and Marble Architecture of Northern Italy in the Middle Ages' (1855); 'Gothic Architecture in Spain' (1865). Consult a memoir by his son, A. E. Street (1888).

STREET, Julian Leonard, American author: b. Chicago, 12 April 1879. He was educated at the public schools and Ridley Preparatory School, Saint Catherines, Ontario. He started as reporter for the New York *Mail and Express* (1899) and had charge of the dramatic department 1900–01. He has written 'My Enemy the Motor' (1908); 'The Need of Change' (1909); 'Paris á la Carte' (1911); 'Ship-Bored' (1911); 'The Goldfish' (1912); 'Welcome to our City' (1913); 'Abroad at Home' (1914); 'The Most Interesting American' (1915); 'American Adventures' (1917).

STREET (Latin *strata,* Anglo-Saxon stræt, road) an open way or thoroughfare within the corporate limits of a city or town. In the rural districts streets are called roads or highways. Very primitive cities seem to have been built without real streets, much after the manner of Indian villages; but as population and the activities of communities grew, the necessity for better means of communication within the towns themselves and between them and the surrounding country arose and called into being the more regular distribution of buildings. In the large cities of pre-Columbian America, with a few notable exceptions, the buildings seem to have been grouped irregularly around a public square, along the four sides of which were paved roads. From this square, at first, exit was had by one or two highways along which were grouped buildings of many kinds. This seems to have been the only evidence of the regular placing of buildings in a town. This constructive plan, or rather lack of plan, is strongly in evidence in the ruins of the cities of the early period of semi-modern civilization in Yucatan. In the ruined city of Uxmal (q.v.) the central plaza is occupied by a great flat-top pyramid, terraced in form, round which are grouped the other important buildings on high pyramids or elevated terraces but without any evidence of plan. But in some of the later cities the pyramid is found surrounded by an open space consisting of the outer edges of the central plaza. From this plaza, roads led in various directions, often for hundreds of miles into the country. These were efficiently paved and maintained at the expense of the general government. From the heart of the city of Itzamal led, far into the interior, four excellently paved roads over which the traffic was immense. Each of these roads started from one of the four corners of the central plaza, the broad ground-level space of which was handsomely paved with carefully-cut large stone blocks. From the ancient Chiapan city of Palenque stretched a well-paved street for over a hundred miles into Guatemala. All along this street, intermittently, were stone buildings, the ruins of which are still in evidence. This was evidently a great highway of commerce and general traffic, especially to the sacred shrines of the city. These great highways seem to have preceded the organization of cities and towns into sections divided by more or less geometrical streets. Most primitive towns are very irregular in their structure and the more primitive they are the more a matter of accident seem to be the arrangement, the width and the construction of the streets, which are generally (when they do exist) narrow, crooked and irregularly placed. Excavations of ruins where one city has been built upon the remains of another show, often, that the older town was much more irregular in its street structure than the later.

As nations began to extend their commerce, trade and other relations, they generally improved their roads and streets. The construction of the magnificent streets of the cities of the Roman Empire seems to have been along the same line of growth as that of the later civilized empires of America. Two necessities compelled the building of magnificent highways — commercial activity and political requirements. No one other factor gave more efficiency to the Roman Empire than its system of magnificent roads. These, in their turn, brought commerce, trade, commercial importance, wealth and luxury to the greater cities. All these called for more sanitary modes of living and better facilities for moving about the cities and towns. This brought into being a more geometrical organization in many cities and towns and the construction of magnificent well-paved streets and avenues, many of which were lined with stone benches and handsome statues. The famous «Appian Way,» known as the «queen of roads,» stretched away from the heart of the Rome of the empire for a distance of 350 miles, every mile of which displayed some feature worthy of attention. It was quite natural that such great roads, lined with magnificent palaces and other noteworthy edifices, should have had their effect upon the streets of the cities of the empire.

But after the fall of Rome the art of city street construction declined throughout Europe. Under Germanic and Gothic influence new cities and towns were constructed with narrow, crooked, unsanitary streets, many of them little better than alley-ways, in which plagues, fevers and other diseases made their homes. When the streets were paved at all it was generally with loose cobble-stones and later with roughly cut stones in the more progressive cities. The old Roman art of building cement ways seems to have been completely lost, forgotten or neglected. Here again the old story has repeated itself. The rapid extension of trade and commerce during the 19th century, the invention of the steam engine, the locomotive and the steamboat called for the extension of highways and the material improvement of those already existing. These, in turn, brought increased population and wealth and importance to the cities and towns. In their train came the improvement of the city streets. The invention of the bicycle and the automobile led, about the beginning of the present century, to the rapid extension of the city boundaries and the introduction of wide avenues and streets in the modern city planning and construction. These factors have brought with them many improvements in street pavement. The ancient cobblestones were replaced by carefully-filled rectangular wooden blocks, cut stone and brick. These are being rapidly replaced by the more durable and sanitary asphalt and cement pavements. Handsome sidewalks are taking the place of the old-fashioned narrow walks of a generation ago. Even in the United States the board walks are disappearing as the price of lumber continues to advance.

The tendency now is more and more to turn over the management of city streets to experts in city planning and beautifying, and it is safe to say that the future city and town street is destined to be as great an improvement on the present street as the present is on that of the past century. The planning of the streets of a city, their connection with proper recreation parks, their pavement, drainage, lighting, water supply, gas conductors, telegraph and telephone lines, street railways, policing, flushing and cleaning, all now form proper subjects of municipal forethought and regulation. The days when the fates took care of the health of a city are past. The health officer has come into his own; and to the attention given by him to the city street is due the banishment of the most fearful of the ancient scourges of great centres of population, making the cities more healthful than the rural districts. (See CITY; MUNICIPAL GOVERNMENT; CITY PLANNING; ROADS AND HIGHWAYS; PAVEMENTS; DRAINAGE; ELECTRIC LIGHTING; RAILWAYS, STREET). Consult Doolittle, F. W., 'Urban Transportation Service' (New York 1916); Holt, R. B., 'Tramway Track Construction' (New York 1915); Robinson, C. M., 'The Wealth and Arrangement of Streets' (New York 1911); 'City Planning' (1916); Walker, E. K., 'City Planning' (*Civic Bulletin*, Berkeley 1914).

STREET CLEANING, a term used to include all operations of municipal departments charged with keeping the streets free from litter which might affect the public health or comfort, or offend the public taste. In the larger cities of the world the work consists of the daily sweeping of all paved streets; the collection of house refuse — garbage, ashes and light waste — when deposited by the householder in cans on the sidewalk or adjacent thereto; the removal of dead animals from the street; summer sprinkling to lay the dust; and the disposal of snow in winter. In small communities the term covers only the more pressing of these functions — the removal of dead animals and household garbage and ashes, with a spring cleaning of the streets after the melting of winter snows, and an autumn cleaning after the fall of the leaves.

The routine work of street sweeping and the removal of household waste is performed by men regularly employed by the department; while work which varies much with the season, such as the removal of dead animals, street sprinkling and the disposal of snow, is, in most cities, let to contractors who are subject to the call of the department, but are better able to supply the sudden demands for men and teams at any point.

For a long time in Europe, and of late in America, the men of the departments of street cleaning have been protected in their employment by civil service rules which insure their positions during efficiency and good conduct: and in Europe they receive pay during sickness and pensions on retirement. This has had the effect of providing a class of men suited to the work and contented with their positions, and in raising the morale of the departments. In Europe the men sometimes wear distinctive caps or some other badge of employment, and in some cities they wear a modest uniform. In New York City the sweepers are garbed in white, because this is most conspicuous on a crowded street and conduces most to the safety of the men and the efficiency of the department; and because these uniforms, to be kept white, must be thoroughly washed and always in good sanitary condition. In many of the older and larger cities of Europe — Vienna, for example — where strict obedience to law has long been rigidly enforced, each householder keeps his portion of the sidewalk uniformly and always clean, having it sprinkled and swept twice daily in summer and kept clean in winter; while in New York few householders regard it as a duty and a point of honor to keep their individual sidewalks clean in summer and free from snow and ice in winter. In New York it is very common to see a newspaper dropped on the street with no protest, whereas in Europe such an act would almost certainly cause a man's arrest if he refused to pick up the paper. There are streets in New York where one sweeper keeps clean 20,000 square yards of pavement; there are other streets, in the crowded districts, where one man's work is to keep clean 1,000 square yards. In the latter case the pavement is laboriously swept seven times daily.

The late Street Commissioner Waring, of New York, at the close of his administration made a report considering in succession 13 factors which were deemed to be beyond the control of the department, and for each was determined approximately its relative difficulty. They were:

(1) Kind of pavement — asphalt, 100; wood, 100, brick, 100; granite, 150; Belgian block, 160; cobble, 400.
(2) Condition of pavement — good, 100; fair, 120; bad, 140.
(3) Amount of traffic — light, 100; medium, 140; heavy, 180; dense, 250.
(4) Amount of car track — on basis of 30-foot street with single track.
(5) Kind of car track rail — none, 100; flat or grooved, 110; T rail, 120.
(6) Amount of sanding — little, 110; much, 120.
(7) Amount of sprinkling — heavy, 125.
(8) Elevated railroad — 110.
(9) Character of population — good, 100; fair, 200; bad, 300.
(10) Presence of schools — 110.
(11) Existence of markets — 125; or (12) Push-cart stands — 175.
(13) Vicinity of unpaved streets — 200.

That a street bears heavy traffic is seen to have more influence on the labor of sweeping than that it has granite instead of asphalt pavement. The amount of traffic affects the cost; but no other single cause contributes so much to the difficulty and expense of sweeping as the action of careless and thoughtless persons in making the public streets the receptacle of all kinds of rubbish — fruit parings, bits of paper, etc.— of which they wish to be rid, and which a little consideration would induce them to deposit in some can which might be emptied into a cart without the trouble of sweeping and shoveling from the pavement.

Machine sweepers (horse or automobile) lessen the cost of street cleaning, and may be used to advantage with preliminary sprinkling on wide, level, well-paved streets, between midnight and dawn; but their service on crowded streets in daytime is impracticable.

A fall of snow is such an impediment to city traffic, which is usually conducted on wheels even in winter, that it is recognized as a duty of the departments of street cleaning to remove it promptly from important streets, especially from the lines of daily food distribution and from the avenues of daily approach to the business districts. The numbers of men and teams suddenly required are very large, and dumping facilities are in general quite inadequate to the work. The cost is also great — about $125 per mile of street per inch of snow, or $1,250 per mile of street for a 10-inch fall. For these reasons numerous efforts have been made to develop practical processes for melting the snow as it lies, or at least on the block where it lies, and running the water into the nearest sewer opening. Machines for the purpose have been tried in many cities for many years, but have usually proved unequal to the task, because of the cost of melting. The most satisfactory method where there is plenty of water in the city pipes, that is well above the freezing point, is to turn a hydrant hose on the snow and wash it down the gutters. Of course this method is applicable only to a light fall, or to the remnant of a heavy snowfall.

In all street dirt disease germs lurk in unknown numbers, and when the dirt is dry and dust is raised by passing traffic or by winds, the dust and the germs find lodgment in eyes, nostrils and mouths, and the work of disease is begun. Of course the dust and the germs are the thicker the nearer the pavement, and no other cause is necessary to explain why the children of the crowded streets are so affected. Careful experiments carried out in New York by Commissioner Woodbury, with germ cultures from plates exposed, some at the curb level and some at six feet above, exhibited a wonderful difference in the number of germs which found lodgment on the plates in different parts of the city. At the curb level the evidence of the plates showed on the average five times as many germs as at six feet above. In a tenement district densely populated, where push carts are numerous and traffic heavy, as many as 9,600 germs were caught in a 15-minute exposure of a plate two and one-fourth inches in diameter. In another part of the city, in a residential district, with heavy traffic but well-flushed pavement, only 54 colonies were found after a 15-minute exposure.

The relative costs of street cleaning in different cities of the world are impossible of comparison, because the conditions and the standards of cleanliness vary so much, and because the work of the department has nowhere been reduced to an exact science. But in general the cost in Europe is much less than in America because of the greater waste and carelessness of the average American citizen, and because of the lower wage cost in Europe. The cost of street cleaning in Manhattan and the Bronx, including the collection and removal of house waste but not the removal of snow, before the war prices set in was about $7,000 annually per mile of street. In Vienna, where only some 25 miles of street in the heart of the city is kept thoroughly clean, the annual cost, excluding snow removal, was about $5,000 per mile. In Budapest, where the pavement is excellent and where much value is recovered by sorting the wastes, the annual cost was not far from $2,000 per mile. In Paris it was about the same. In Brussels the cost was about $1,350 per mile. In Birmingham, England, the cost was still less, though wages were higher than on the Continent. See WASTES, CITY, DISPOSAL OF.

STREET RAILWAYS. See AMERICAN STREET RAILWAYS; RAILWAYS, STREET.

STREIGHT'S RAID FROM TUSCUMBIA, Ala. In the spring of 1863 General Rosecrans organized an expedition to cut the communications of General Bragg's army, then at Tullahoma, Tenn. The objective point was the railroad south of Dalton in northwestern Georgia. For this purpose Col. A. D. Streight, 51st Indiana, who had suggested the expedition, was designated to lead it, and was given a provisional infantry brigade of 1,700 men, composed of the 51st and 73d Indiana, 80th Illinois, Third Ohio and two companies of Tennessee cavalry. He was ordered to Nashville to organize the expedition. His instructions were to descend the Cumberland River to Palmyra, thence to Fort Henry, on the Tennessee, and sweep around the rear of Bragg's army, cut all his railroad communications in northern Georgia, destroying manufactories and depots of supplies, and in every way to cripple the Confederates. Having obtained a partial outfit of unserviceable mules, depending upon the country for a further supply, Streight left Nashville 11 April, with his troops on steamboats, and landed at Palmyra, from which point he marched across to Fort Henry, gathering on the way as many serviceable mules as possible. He remained at Fort Henry until the fleet of steamboats went down the Ohio and up the Tennessee to that point, when he again embarked his men on the 17th and landed at Eastport on the 20th of April. On the 21st, with General Dodge, who with 7,000 cavalry and infantry had marched by way of Corinth and Iuka, to protect the movement, he moved on Tuscumbia to mask his real intention. Following Dodge, who steadily pushed back Roddey's cavalry, he arrived at Tuscumbia on the 24th, and being supplied by Dodge with some animals and rations, and leaving his sick and disabled men with Dodge, who was to return to Corinth, after holding the enemy until Streight could get a good start, at midnight of 26 April, with only 300 of his 1,500 men on foot, Streight cut loose from Dodge, started southward in a heavy storm, and scouring the country for horses and mules arrived at Moulton, after some slight skirmishing, about dark of the 28th. At midnight, every man being mounted, he resumed the march eastward to Day's Gap, about 35 miles, bivouacking on the night of the 29th at the east foot of the gap. March was resumed before daylight next morning, and before his rear guard had cleared the gap Forrest's cavalry was upon it. With 1,200 men and eight guns Forrest had left Courtland, Ala., 16 miles north of Moulton, at the same hour Streight had left Moulton, and with scarcely a halt had overtaken him. Streight formed an ambuscade into which Forrest rode and was repulsed with the loss of two of his guns. This check, with Forrest's necessity for rest, gave Streight an advantage of time, which he improved, and in the forenoon of 1 May he reached Blountsville, after a running fight in which he was hard pressed and some of his men captured. Here Streight seized fresh animals, discarded wornout ones, distributed ammunition and rations, burned his wagons and near noon started for Rome, Ga., the seat of extensive iron works, which he thought to destroy. His column was not fairly in motion before his rear guard was attacked in the streets of the town. There was a running fight from Blountsville to the Black Warrior River, and upon reaching the river Streight was compelled to make a stand. Forrest was beaten off, and at 5 P.M. Streight crossed the river and moved on with but little more interruption, until 9 A.M. of the 2d, when his rear guard was fiercely attacked at the crossing of Black Creek, near Gadsden. Forrest was held in check some time by the burning of the bridge and Streight continued the march to Gadsden, where he made a short halt to rest his men and animals. Continuing the march at 4 P.M., he again halted 15 miles beyond Gadsden to procure forage for his animals. Meanwhile Forrest was pressing him closely, drove in his rear guard and made a general attack, in which he was repulsed and fell back, and as it was growing dark Streight withdrew half a mile; but Forrest moving to flank him, he again resumed his retreat intending to reach Rome and burn the bridge over the Chattooga. When, near Cedar Bluffs, Ala., he was again overtaken and attacked by Forrest, he found the bridge over the Chattooga held by the enemy; his men and horses had broken down; he had no hope of accomplishing the principal object of his expedition; and at noon 3 May he surrendered 1,365 men. He had lost in killed, wounded and captured prior to the surrender 145 men. The captives were sent to Richmond and confined in Libby prison, from which Streight escaped in February 1864 by burrowing under the foundation walls. Consult 'Official Records' (Vol. XXIII); Wyeth, 'Life of Gen. N. B. Forrest.'

E. A. CARMAN.

STRELETS (pl. *Streltsi*), Russian, sharpshooter, the life-guards of the Russian tsars until the reign of Peter the Great. They were instituted by Ivan the Terrible in the latter half of the 16th century as a national guard; for 200 years they rendered valuable service to the empire. They amounted sometimes to 40,000 highly-trained men. Their numerous privileges and their frequent insurrections made them as formidable as the Roman prætorians or the Turkish janissaries. On the death of Tsar Feodor in 1682, the double family of Alexis, his father, struggled to seize the crown. The Streltsi joined in the revolt of the people of Moscow caused by false rumors that the young tsarevitch Ivan (half-brother of Peter), had been strangled. Followed by an immense crowd, 20,000 Streltsi marched to the Kremlin, dragging cannon behind them. When the dowager tsaritsa appeared with the two princes the revolt was almost ended. A violent harangue against the rioters by Prince Mikhael Dolgoruki inflamed the Streltsi, who flung him from the top of the red staircase upon their pikes. They sacked the palace, murdering all who fell into their hands. The violent reforms of Peter the Great met with strong opposition from the Streltsi, who likewise suffered hardships and privations while campaigning in distant and inhospitable regions. Thousands deserted from the ranks while Peter was abroad in 1697; others revolted, deposed their officers and marched against Moscow. They were stopped on the banks of the Istra by Generals Gordon and Schein with regular troops. The Streltsi presented a petition setting forth their grievances, when 4,600 were arrested. Peter hastened home from Vienna, determined to crush the turbulent troops. Hundreds of the Streltsi underwent terrible tortures; 230 were taken in carts to the Red Place in Moscow on 1 Oct. 1698, followed by their wives and children. In seven days a thousand Streltsi were executed. Peter obliged his nobles to assist at the wholesale slaughter, and it is said that on the last day the tsar himself chopped off the heads of 84 Streltsi. The removal of the corpses was forbidden; "for five months the Muscovites had before their eyes the spectacle of the dead bodies hanging from the battlements of the Kremlin and the other ramparts." The Streltsi as a distinot organization ceased to exist. Some 20,000 of the survivors were distributed among the regular army.

STRELITZIA, a genus of perennial herbs of the family *Musaceæ*. The species, of which there are less than half a dozen, are natives of South Africa, and are called bird of paradise flowers. They have stout rhizomes, more or less woody, usually short stems, long petioled, generally large paddle-like leaves, and showy flowers of striking form. The genus is closely related to *Musa* (banana, plantain, etc.), *Ravenala* (travelers' tree of Madagascar), *Maranta, Curcuma* and *Canna* (some of which furnish starch and arrowroot). The best-known species (*S. reginæ*) grows about three feet tall, and has a spathe about six inches long, purplish at its base, and surrounding the bases of about six orange and bluish-purple flowers.

STRENGTH OF MATERIALS. The relation between force and the distortion it produces in materials of construction (metal, stone, timber, etc.), the harmful effects of force, and the proportioning of materials safely to resist given forces are studied under this title. For brief notes on the history of the subject see the article ELASTICITY.

Stress and Strain.— Since forces are distributed over surfaces, and not concentrated at points as in the mechanics of rigid bodies, the concept of force-per-unit-area is of fundamental importance; it is called *stress* in this article although stress is generally used as being synonymous with force; this use is confusing as well as superfluous. If the stress is normal (perpendicular) to the surface on which it acts it is called normal, or tensile or compressive stress; if tangential it is called *shear*. The deformation resulting from the application of force may be manifested as a change of length, of area or cross-section, of volume, or of angle. The change of length (or area, or volume) *per unit length* (or area, or volume) is called linear (or areal, or volumetric) *strain*. Strains are purely numerical ratios; they are not lengths, areas or volumes. If a rectangle drawn on any plane in a stressed material is distorted into a parallelogram the change, in radians, of any one of its right-angles is called the shear strain for reasons which will be evident presently. The deformation produced by stress requires time to develop. Tar, for instance, is brittle or fragile under quickly applied loads and breaks, like flint, with a smooth conchoidal fracture. It behaves like a very rigid solid under sudden blows, but under the smallest forces applied for a long time it flows as if it were a liquid; under gradually applied large forces it is plastic and can be kneaded like dough or putty. Metals behave in the same kind of way but to a decidedly smaller extent. The full effect of stress is not produced immediately although the greater part arises very quickly. If the stress is removed some of the distortion disappears at once, some takes hours, days or even months to vanish, and some remains permanently. The property of recovering from deformation is called *elasticity*. A body that recovers completely and resumes its original dimensions is said to be perfectly elastic for the particular stress that acted on it. The slow return to shape, occurring during the second period of recovery, is the elastic *after-effect* discovered by Weber in 1835; some very curious phenomena are associated with it. The after-effect has thus far been of no importance in engineering but it is not unlikely that its study will help to clear up difficulties met with in the molecular derangements resulting from stress. For an exhaustive account consult the article by Braun and Jaeger in Winkelmann's 'Handbuch der Physik,' Vol. I, 1908.

Laws of Elasticity.— For many metals and certain other materials the laws of elasticity, i.e., the relations between stress and strain, are quite simple; they date from the time of Hooke in 1678. If a tensile or compressive force F is applied at the end of a rod or bar of length l and cross-section A it produces a change of length Δl; if the force is not too large these quantities are connected by the experimentally discovered equation

$$\frac{F}{A} = \frac{E\Delta l}{l}.$$

In terms of stress and strain, putting $F/A = p$ and $\Delta l/l = s$, we have

$$p = Es$$

where E is a constant called Young modulus; its value depends on the material and, within certain limits, not upon the stress. For iron and steel E is the same for tension as compression; for cast iron and stone this linear relation does not hold at all; for wood E depends upon whether p is along or across the grain. Typical values of E in pounds per square inch are steel (tens. or comp.) 30,000,000; cast iron (tens.) 15,000,000; concrete (comp.) 2,000,000; wood (along grain) 1,500,000.

When a bar is stretched (compressed) longitudinally its cross-section gets smaller (larger) without change of shape, all transverse dimensions in any plane growing proportionally smaller (larger). If s is the longitudinal strain and s' the lateral strain — the strain of any line in a cross-section —

$$s' = s/m$$

where m is constant for a given material and generally independent of the stress. $1/m$ is called *Poisson's ratio* (See article ELASTICITY); for steel and iron $1/m = 0.3$ approximately.

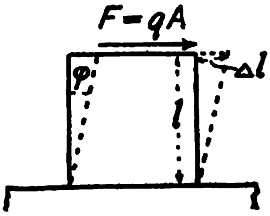

FIG. 1.

Experiment shows that if a tangential force acts on top of a block fastened at the base, as in Fig. 1, the displacement of the top is within certain limits proportional to the force, i.e. $F \propto \Delta l$. Using q for the shear stress we may write this in the form

$$q = G \tan \phi.$$

In nearly all cases ϕ is so small as to be very closely equal to its tangent

$$\therefore q = G\phi$$

where G is the modulus of shear or modulus of rigidity; it depends on the material but in many cases not upon the stress. ϕ is the angle of shear or the shear strain; it must be measured in radians. Typical values of G in pounds per square inch are: Steel, 12,000,000; cast iron, 6,000,000; stone, 1,800,00; wood (across grain), 400,000.

All materials are compressible. If a cubical block is subjected to equal compressive stresses p on all six faces experiment shows that the volumetric strain, $\Delta v/v$, varies directly as p, i.e.

$$p = \frac{K \Delta v}{v}$$

where K is the bulk modulus and depends only on the material. As proved in the article ELASTICITY the four constants E, G, K and m are related as follows:

$$mE = 2G(1+m) = 3K(m-2).$$

Testing Machines.— It would seem to be comparatively simple to find experimentally the safe stress a body can carry. Yet it is not simple because it is difficult to test for one kind of stress without having some other kind present; furthermore it is not definitely known what stress or combination of stresses is the ultimate cause of failure. The precise meaning of the word «strength» is not fully understood; that is, we do not know upon what properties of a material its strength depends. The best we can do in the physical testing of materials is to find by direct and, if possible, imitative experiments the values of the elastic constants and the stresses p and q that enter the formulas derived in the rational mechanics of perfectly elastic bodies. Shear stresses are best found by experiments on circular shafts in torsion; tensile tests are made by subjecting a test piece of specified size and shape to direct pull. As both kinds of tests are made in about the same way we shall, on account of lack of space, describe only the latter. Testing machines differ in the devices used for applying and measuring the loads; they are fully discussed in Johnson, J. B., 'The Materials of Construction' (1919); Martens, Adolf, 'Handbook of Testing Materials' (translated by Henning, 1899); Unwin, 'Testing of Materials' (1910).

Testing machines may be divided broadly into three classes according to the manner in which the applied load is measured: (1) lever balance; (2) hydraulic press gage; (3) spring balance. In type (1) the load is applied by means of a screw-press or a hydraulic press but is measured with a lever balance as in the ordinary platform scales. Fig. 2 (a), after Martens, is a schematic representation of this type; it shows only the bare principle and omits the actual arrangement of levers, supporting frame, method of gripping and applying the load, measuring the extension and details of design. The machines made by Riehlé and by Olsen are of this kind; so are those made by Wicksteed in England, Martens in Germany and Marié in France, except that the lever system is attached to the upper shackle or clamp. The Olsen at the Bureau of Standards in Pittsburgh is the most powerful machine in the world, having a capacity of 10,000,000 pounds compression; it is used for tests on full-size columns and masonry piers. In type (2) one of the shackles is connected to the diaphragm of a hydraulic chamber the pressure in which is read on a gage. The load is applied at the other shackle either mechanically or hydrostatically. Fig. 2 (b) shows the essentials of an Emery machine. The Emery, designed at the Watertown arsenal in 1879 for the United States government, differs from other types in having flexible steel plate-fulcra instead of knife edges; the one at the Bureau of Standards in Washington can take specimens 35 feet long and subject them to a push of 2,300,000 pounds or a pull of half as much. The Martens machine is similar to Fig. 2(b) only the diaphragm is so arranged as to compress the water in the gage chamber; in the Whitworth a gage is attached directly to the hydraulic press that applies the load. Type (3) is represented by the Dalby weigh-bar machine. (Consult Dalby, 'An Optical Load Extension Indicator,' in Proceedings Royal Society, Vol. LXXXVI, 1912; 'Load Extension Diagrams', ib., Vol. 88, 1913; *The Engineer* 1917; pp. 422, 453, 468). Dalby describes it thus: «The instrument is self-contained and its principal element is a hollow bar of fine steel about a foot long. This bar, called the weigh-bar, hangs by one end from the upper shackle of a vertical testing machine. The other end is coupled to the specimen bar to be broken, and the lower end of the specimen bar is secured in the lower shackle of the testing machine. . . . The cross-sections of the bars

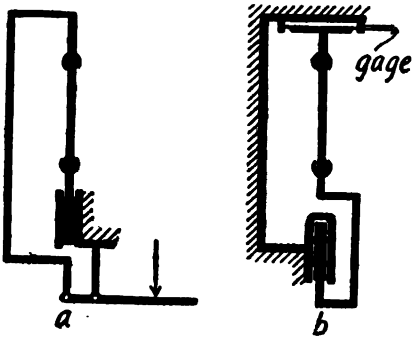

FIG. 2.

are proportioned so that the pull applied through them is ultimately able to break the specimen bar without loading the weigh-bar beyond its elastic limit. . . . The stretch of the weigh-bar is used to determine the load,’ and is measured by the movement of a spot of light recorded on a photographic plate. The spot moves horizontally in proportion to the load on the weigh-bar and vertically in proportion to the stretch of the specimen bar; the resultant locus on the photographic plate is the load-stretch diagram of the specimen which is being tested. The idea used by Dalby is not new but he has employed it very skilfully. Actual spring balances were in existence long before in small machines for testing paper, cloth and wire; in 1890 Martens designed a 50-ton machine having a steel bar instead of a spring and Kennedy and Ashcroft had employed a similar device in 1886. Dalby's form is superior to the earlier ones because the inertia of the moving parts is reduced to a very small minimum and the recording, being photographic, does away with the unavoidable friction of pencil recorders. Diagrams may be taken in less than two seconds from start to break.

Extensometers.— Elastic deformations are usually so small that delicate instruments are required in measuring them. Fig. 3 shows in bare principle several types of extensometers or extension-measurers; for more detailed information consult the works by Martens, Johnson and Unwin cited above, and also Morrow, ‘Measurement of Strains’ (in Proc. Inst. Mech. Eng., April 1904); Dalby's photographic extensometer is described in the references already given. In the direct form, Fig. 3, two brackets are clamped to the specimen bar at a fixed distance apart. The stretch of this length is found by noting the separation between the end of a micrometer screw on the upper clamp and the end of a fixed rod on the lower. In Ewing's extensometer the stretch is read through a small telescope focused on a scale attached to the lower clamp; multiplying levers (not shown here) are used so that readings may be taken to a precision of one part in 50,000. The displacement of the end of the lever in Goodman's instrument is read on a circular scale. The form devised by Martens is extremely delicate and precise but correspondingly difficult to calibrate and to use. A double knife-edge carrying a mirror *M* is supported between the test piece and a stationary or idle rod; relative motion due to stretching tilts the mirror and the angular deflection of a ray of light reflected by it is measured on a scale. Several recording extensometers have been used but the best is that of Dalby.

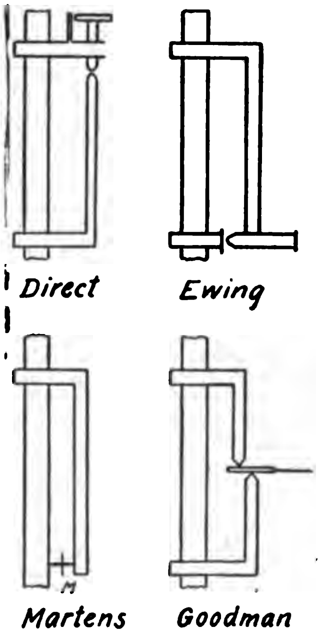

FIG. 3.

Shape of Test Pieces.— Elastic properties and strength depend on the shape and size of the test specimen for several reasons. Local stresses due to clamps and grips have greater disturbing effects on small pieces than on large; rolling, machining, etc., produce a surface layer which, like the capillary film on liquids, has properties different from those within the material; blow-holes, minute cracks and particles of foreign substance are relatively larger in smaller specimens; stress tends to concentrate itself at corners, edges, abrupt changes in section and internal cavities so that in a test piece having such peculiarities it is difficult to learn what stress really acts; the planes or surfaces of separation between the molecular crystal groups which are known to exist in even the most homogeneous metals are oriented differently throughout the mass as a result of which two specimens cut from the same body show somewhat different properties. The differences which have been observed between the strengths of long and short round bars cut from the same stock are due largely to lack of homogeneity. Chaplin (in *Van Nostrand's Engineering Magazine*, December 1880 and in Proceedings Engineers Club, Philadelphia, March 1882) has calculated them by means of the theory of probabilities. It is evident, therefore, that tests give comparative results at best. The American Society for Testing Materials accordingly specifies a piece about 18 inches long and two inches in diameter, the middle nine inches being turned to a diameter of one and a half inches and the three cylinders thus formed running smoothly — without shoulders — into one another. The British Standards Committee recommends a cylindrical bar of a length equal to nine times its diameter, extension to be measured on a middle length of not less than eight diameters. Numerous experiments, especially those by Bauschinger and Martens, have shown that the relations between shape and strength follow closely the law suggested by Barba (*Memoirs de la Society des Ingenieurs Civil*, 1880, I, p. 682): Under identical conditions geometrically similar bodies of the same material suffer similar deformations under the same stresses. ‘Identical conditions’ are difficult to realize in practice. An approximation to Barba's law will obtain if the ratio of the length of a bar to the square root of its section area is constant; a length of 20 to an area of π would be convenient as a standard but is considered to be too expensive to prepare for use in commercial tests.

Stress-strain Diagrams.—Hooke's law is only a partial statement of stress-strain relations and sometimes does not apply at all. The behavior of wrought iron and structural steel under tension in the testing machine is exhibited graphically in Fig 4 which is exaggerated in order to show characteristic peculiarities. Compression tests are not satisfactory from a strictly scientific standpoint: long specimens tend to bend or buckle and in short blocks the local strains produced at the ends manifest themselves too strongly even when the compression plates are well lubricated—as they usually are not. Up to a certain point P stress is proportional to strain and the graph is a straight line of which the modulus E is the slope; the slope seems to be unaffected by cold-working the material whence Rosenhain concludes that E depends more on the nature of the atoms themselves than on their arrangement. P is the *proportionality limit* and marks the point beyond which Hooke's law ceases to hold; the material may or may not be perfectly elastic within this region or beyond it. The limit of perfect elasticity—briefly, the *elastic limit*—depends on the accuracy with which small extensions can be measured and very largely on the previous history of the material. (Consult the discussion by Bairstow, Phil. Trans. Roy. Soc. 1912). For practical purposes P may be regarded as coincident with the elastic limit. At P, which of course is not a sharply marked point, the locus begins to curve downward until Y, the *yield point*, is reached; Y is always beyond the elastic limit. All the strains up to Y develop simultaneously with the stresses; beyond Y they do not attain their full values until considerable time has elapsed. This plastic flow or slow growth of strain under constant stress has been called 'creeping' by Ewing; when the stress is removed the strain creeps back but does not wholly disappear. This lagging in the diminution of strain is named *hysteresis* and belongs to the group of phenomena associated with the elastic after-effect; see the reference above. Plastic flow occurs with hardly any increase of volume; during elastic strain the cross sections change according to Poisson's law. The serrated part of the curve, Y to A, occurs only in wrought iron and mild steel; it indicates unstable re-adjustments in crystal grouping. Real ductile distortion begins at A, and a waist of hour-glass shape starts to form near the middle of the test piece. If the stresses are calculated by dividing the load by the *original cross-section* the curve runs through M to R the point of rupture. This gives *nominal* stresses; the actual stresses determined by using the actual area of section—must be computed as they cannot be plotted by automatic recorders.

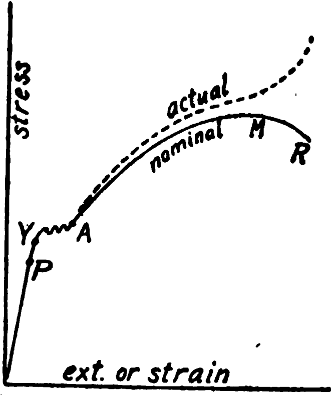

FIG. 4.

Other materials show characteristically different curves. With increase of carbon, nickel, or chromium the serrated line in the strain diagram of steel smooths out and plastic ductility sets in immediately after the yield point; the curve from A onward is different enough in each case to indicate quite closely the nature of the metal under test. Neither cast iron (in tension or compression) not concrete (in compression) follows Hooke's law. Some writers infer from this that these materials are never perfectly elastic. This is unjustifiable because there is at present no known connection between perfect elasticity and the proportionality of stress and strain. Conclusions drawn from experiments on cast iron are unsatisfactory on account of the existence of initial stress due to sudden cooling. Rolled aluminium does not obey Hooke's law but is decidedly elastic. For materials such as these Bach and Schüle have proposed the empirical law

$$p^n = Es$$

where n is a constant equal in the case of cast iron in tension to 1.07.

Stress Relations.—In most engineering problems the stresses at any point in a body are all parallel to one plane and are, therefore, called *plane* stresses; we shall limit the discussion to this case. Stress on one plane at any point produces stress on every plane at that point. Fig. 5 shows an infinitesimal element in the most general state of plane stress, there being by assumption no stresses perpendicular to the paper. The stresses on any face, for example the left, are p_1 normal, and q_1 tangential; the corresponding forces are p_1dy and q_1dy if the thickness is unity; the other stresses are assumed to act as in the diagram. As the element is in equilibrium unless vibrations occur the sum of the moments of all forces—not stresses—about a central axis normal to the paper must vanish; although the stress may vary from point to point it is constant over an infinitesimal area. Hence

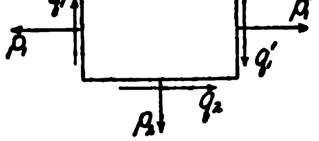

FIG. 5

$$\tfrac{1}{2}(q_2 \pm q'_2)\,dxdy = \tfrac{1}{2}(q_1 + q'_1)\,dydx.$$

In the limit $q'_1 = q_1$ and $q_2 = q'_2 \therefore q_1 = q_2$ or: shear stress on any plane through a point is always accompanied by equal shear stress on a perpendicular plane through that point, both stresses acting away from or toward the edge of intersection and normal to it. This is Cauchy's theorem.

If the stresses on two planes X and Y at a point P are known as in Fig. 6, the stress on any other plane *through that point* can be found. Pass any plane at an infinitesimal distance from P and take the wedge thus formed as a free body. There will in general be normal and shear stresses p' and q' on the oblique plane. If the hypothenuse of the wedge has an area dA the forces on it will be $p'dA$ and $q'dA$; the horizontal force on the vertical face is $p_x dA \sin\theta$, and so on for the other forces. By resolving along p' and q' respectively and replacing functions of θ by functions of 2θ we get

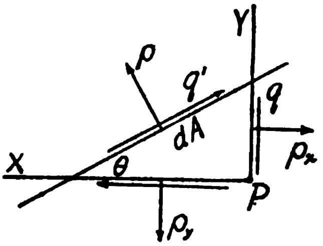

FIG. 6.

$$p' = \frac{p_x - p_y}{2} - \frac{p_x - p_y}{2} \cos 2\theta - q \sin 2\theta \ldots \quad (1)$$

$$q' = \frac{p_x + p_y}{2} \sin 2\theta - q \cos 2\theta \quad (2)$$

which remain unchanged when dA becomes zero. They are the stresses *at* P on any oblique plane of angle θ.

When $q' = 0$

$$\tan 2\theta = \frac{2q}{p_x - p_y} \quad (3)$$

which, being satisfied by the two values θ and $\theta + 90°$, shows that there are always two orthogonal planes free from shear stress. They are called *principal planes* and the pure normal stresses on them principal stresses. If (3) is substituted into (1) the principal stresses, say p_1 and p_2, are found to be

$$p_1, p_2 = \frac{p_x + p_y}{2} \pm \tfrac{1}{2}\sqrt{(p_x - p_y)^2 + 4q^2} \ldots \quad (4)$$

By putting $dp'/d\theta$ from (1) equal to zero we get the important fact that the principal stresses are the largest and smallest normal stresses in the body at P.

While there are always two pure normal stresses, pure shear exists only under special conditions. Take, instead of X and Y, the principal planes as the planes of reference. Then in (1) and (2) q drops out, p_x and p_y must be replaced by P_1 and P_2, and θ stands for the angle between the oblique plane and one of the principal planes;

$$\therefore\ p' = \frac{p_1 + p_2}{2} - \frac{p_1 - p_2}{2} \cos 2\theta \ \ldots \quad (5)$$

$$q' = \frac{p_1 - p_2}{2} \sin 2\theta \ldots \quad (6)$$

The condition for pure shear on the oblique plane is $p' = 0$ from which

$$2\theta = \frac{p_1 + p_2}{p_1 - p_2};$$

this is impossible unless p_1 and p_2 are opposite in sign or unlike in sense. Hence pure shear exists only when the principal stresses are unlike. If they are unlike but numerically equal, $\theta = 45°$. But pure shears are not in general the greatest or least shears. It is evident from (6) that maximum and minimum shears occur when $\theta = 45°$; in other words, the planes of maximum and minimum (greatest numerical) shear lie at 45° to the principal planes. The largest shear stress is, therefore,

$$q' = \tfrac{1}{2}(p_1 - p_2) = \tfrac{1}{2}\sqrt{(p_x - p_y)^2 + 4q^2} \ldots (7)$$

The effect of a stress p is a strain p/E in the direction of P and, by Poisson's law, a lateral strain p/mE perpendicular to P; they are opposite in sign. Consequently when a block is acted on by tensions p_1 on one pair of opposite faces and tensions p_2 on a pair perpendicular to the first, the resultant strain E_1 along p_1 is

$$E_1 = \frac{p_1}{E} - \frac{p_2}{mE}. \quad (8)$$

A single stress equal to Ee_1 acting alone in the direction of p_1 will produce the same strain in this direction as both p_1 and p_2; in this respect it is equivalent to them and is called the *equivalent simple stress.*

Working Stress; Elastic Failure.— The mechanics of elastic bodies is of limited value in rational designing and serves only as a refined rule of thumb until it is decided how large a stress or strain a material can safely resist, how large a stress causes ultimate rupture and finally whether failure is produced by normal or shear stress or by some combination of them. Researches initiated by Wöhler in 1870 and continued by Bauschinger, Reynolds and Smith (Phil. Trans., Roy. Soc., 1902, p. 265), Stanton and Bairstow (Proc. Inst., Civil Engineering, 1906, Vol. CLXVI, p. 78), and others have shown that alternating stresses (tension to compression) well below the elastic limit may produce rupture when repeated often enough. A familiar illustration of this phenomenon is that springs do not last forever, although they might never be stressed beyond the so-called "safe" limit. It used to be believed that these reversals caused the material to crystallize or become granular. This is now known to be incorrect; all inorganic bodies are crystalline under the microscope, and reversed stresses, or even fluctuating ones always of the same kind, weaken the material by causing grinding and abrasion on planes of cleavage. Investigations solely with the aid of testing machines will throw probably little light on the subject. The most fruitful results are undoubtedly to be looked for in the comparatively new field of *metallography.* This is concerned with the microscopic examination of internal structure. The first attempt to bring the microscope to the aid of the testing machine was made in 1864 by Sorby of Sheffield, whose work, however, remained unknown until it was independently taken up again by Martens in Germany and Osmond in France. The subject is too large to be discussed in a short article. Consult Mellor, 'Crystallization of Iron and Steel' (1905); Rosenhain, 'Introduction to Physical Metallurgy' (1917), and Humphrey, 'Metallography of Strain' (1919).

Both strength and stiffness need to be considered in designing. No structural member may yield or give more than a certain amount apart from the question of strength. For instance, if a floor beam sags by an amount greater than about one-third per cent of its length a plastered ceiling under it will crack. Questions of rigidity or stiffness are decided by means of mathematical formulas derived either from the principles of mechanics or empirically. They are based on Hooke's law and on the assumption that the elastic limit is not exceeded. The usual method of checking them is to compare calculated with experimentally found deformations; the calculated stresses are difficult to verify because we have no direct method of measuring stress within a body. However, use has been made of the well-known fact discovered by Brewster in 1815 that an isotropic transparent medium is made doubly refracting by stress and breaks plane polarized light into orthogonal components; likewise, circularly polarized waves become elliptically polarized. Wilson, Carus (in *Phil. Mag.*, Vol. XXXII, 1891, p. 481); Hönigsberg (in *Zeitschrift öst. Ing. Verein,* 1904, Nr. 11); Mesnager (in *Annales des Ponts et Chaussées,* Fasc. iv, 1913) and Coker (in *Engineering,* Vol. XCI, p. 1), examined the optical properties of various structural elements made of celluloid and glass and found a remarkably close agreement between theory and fact. Of the many books dealing with the formulas of the mechanics of materials the most complete are Morley, ‘Strength of Materials’ (1908 and later editions), and Bach, ‘Elastizität und Festigkeit’ (5th ed., 1905).

The working stress is the greatest stress to which a member of a structure or a machine is subjected during use or operation. If it exceeds the elastic limit there may occur permanent deformations not allowed for in the design, change of properties of the material, and when the stresses alternate or vary, ultimate failure. Indeed, the working or safe stress must be taken considerably below the elastic limit to allow for deterioration due to wear, unavoidable imperfections in workmanship and manufacture, lack of uniformity of material, accidental overloading, but *not for poor design.* As it is difficult under commercial conditions to determine the rather ill defined elastic limit it is customary to state the safe stress as a certain fraction, $1/n$, of the breaking stress; n is called the *factor of safety* and is determined by experience. According to the experiments of Wöhler and Bauschinger on steady, fluctuating, and alternating loads, the safe stresses are in these cases roughly in the ratios 3:2:1, which are, therefore, taken as a guide in determining the factors. The building laws of many cities in the United States specify definite, safe stresses instead of factors of safety. For recent data consult Marks, ‘Mechanical Engineers' Handbook’ (1917); Merriman, ‘American Civil Engineers' Pocket Book’ (1916).

A material is simple tension or compression, or simple shear is considered to be overloaded when the corresponding safe stresses, as defined above, are exceeded. The immediate cause of failure in the case of compound stress — a number of stresses acting simultaneously — is still a matter of dispute. A material fails when the yield point is reached. Lamé assumed that the largest principal stress produced yielding; this theory is sometimes called after Rankine because he gave it considerable authority by using it in his ‘Applied Mechanics’ (1858), and it is generally followed by American and English engineers. In it the effect of the other principal stresses is disregarded, which implies that a block under compression on top and bottom is just as strong as it would be if it were prevented from expanding laterally. Poncelet and Saint Venant believed that excessive *strain* caused failure, i.e., stress is harmful only in so far as it produces molecular separation. From this point of view, the equivalent simple stress must not exceed the working stress. Coulomb, Tresca and G. H. Darwin proposed the theory that the difference between the principal stresses, i.e., the greatest shear — eq. (7) above — is a measure of strength. Recent experiments have given some confirmation to it, at least for ductile metals. Consult Guest, ‘Strength of Ductile Materials under Combined Stress’ (in *Phil. Mag.*, 1900, Vol. L); Hancock, ‘Effect of Combined Stresses’ (ib., 1906, Vols. XI, XII); Scoble, ‘Strength of Ductile Materials under Combined Stress’ (ib., 1906, Vol. XII). The latest theory is that of Mohr (in *Zeit. Verein d. Ing.*, Vol. XLIV, 1900, p. 1524, Vol. XLV, 1901, pp. 4, 740), the essential hypotheses of which are: (a) failure depends only on the normal stress on the surface of rupture; (b) the surface of rupture is normal to the planes of greatest and least principal stresses [for space stresses there are three principal planes], i.e., is parallel to the principal plane of intermediate stress and is independent of that stress.

In the absence of conclusive experiments it is necessary to design independently for greatest shear, greatest normal stress and greatest equivalent simple stress; this errs on the side of safety. Metallographical researches have shown such great differences in the molecular structure of materials that a complete theory of elastic strength will probably have to take structure into consideration instead of, as now, dealing only with the geometric arrangement of the stress vectors on the one hand and the stress-strain curve on the other.

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STRENUOUS LIFE, The, a collection of 13 essays and addresses on various subjects by Theodore Roosevelt, published in 1900. The book takes its title from the first of the series.

STREPTOCOCCUS. See COCCUS.

STRETFORD, strĕt'fōrd, a town in Lancashire, England, four miles southwest of Manchester. Among its chief features are a public hall, municipal offices, a free library, charitable institutions and botanical gardens. It has numerous cotton factories. Pop. about 50,000.

STRETTON, strĕt'ŏn, **Hesba,** the pseudonym of Hannah Smith, English novelist, who began writing fiction in 1859. Among her 40 or more books are ‘Bedés' Charity,’ by which she is best known; ‘The Doctor's Dilemma’; ‘Hester Morley's Promise’; ‘Soul of Honor.’ Her works are deservedly popular and have been translated into all of the European and several of the Asiatic languages.

STRIÆ, grooves or scratches on rock. These are commonly produced by glaciation, as a result of bowlders frozen into the ice scratching against bed-rock. As the bowlder may break loose in the ice and turn its position, and then freeze fast again, bowlders may be striated in several directions. More than one set of striæ on the bed-rock, however, means one advance of the ice following another from a different direction. Striæ are also produced by faulting. See Fault; Slickensides; Glacier, and section on *Glaciers* in article on Geology.

STRICKLAND, strĭk'lạnd, **Agnes,** English historical writer: b. Reydon Hall, Suffolk, 19 Aug. 1806; d. there, 8 July 1874. She was one of five sisters, all of whom were writers. Her first work, in which she was aided by her sister Susannah, was a volume of 'Patriotic Songs,' followed by 'Worcester Field,' a historical poem. Her later works were 'Queen Victoria from her Birth to her Bridal' (1840); 'Historic Scenes and Poetic Fancies' (1850); 'Lives of the Bachelor Kings of England' (1861); 'Lives of the Seven Bishops' (1866); 'Lives of the Tudor Princesses' (1868). Her best works are 'Lives of the Queens of England' (12 vols., 1840–48), and 'Lives of the Queens of Scotland' (8 vols., 1850–59); 'How Will It End?' (1865); 'Lives of the Last Four Stuart Princes' (1872). In these her sister Elizabeth collaborated, but at the latter's own desire her name was not revealed as co-author with Agnes. Miss Strickland's work is very readable and has been exceedingly popular, but belongs to a school of historical writing now gone by. Consult 'Life' by her sister Jane (1887); and 'Pearls and Pebbles' by Mrs. Catherine P. Traill, another sister (London 1894).

STRICT CONSTRUCTIONISTS, in American politics, those who believe the Federal government has no rights nor powers which are not expressly granted by the Constitution. The Anti-Federalists (q.v.) were strict constructionists. The broad constructionists, on the contrary, believe that a liberal view of the power and intentions of the Constitution should be held and that the Federal government should not be bound by an inflexible law preventing the natural growth of the democratic institutions of the country. The strict and the broad constructionists have come into conflict often in the history of the American Republic, the most notable occurrence being in the struggle over slavery. The strongest supporters of the strict-construction point of view have been the Anti-Federalists and the Democratic party, who were opposed by the Federalists, National Republicans, Free-soil and modern Republican parties. Of late years the Strict Constructionists have lost ground so rapidly that their contentions no longer form an issue in American politics.

STRICT OBSERVANCE, Friars of. See Orders, Religious.

STRICTURE, a morbid contraction of a mucous canal or duct of the body, as the urethra, œsophagus, or intestine. When the affected part is not mentioned, and a person is stated to suffer from stricture, it is always the urethral canal that is referred to. Contraction of this canal may be either permanent or transitory. The first form is due to a thickening of the walls of the urethra in consequence of organic deposits, and is hence termed organic stricture. The second may be due either to local inflammation or congestion, or to abnormal muscular action, the first of these varieties being inflammatory or congestive stricture, and the second spasmodic stricture, of which the last named seldom exists except as a complication of the other kinds of stricture. There are two principal causes of organic stricture, inflammation of the canal, and injury by violence. Inflammation is by far the most common cause, and gonorrhœa is the common agent by which it is excited. It is only in exceptional cases that a stricture results from inflammation of the urethra. Stricture in the second case arises from such causes as falling across spars, scaffolding, ladders, etc., or from some sharp object which punctures the perinæum.

The earlier symptoms of stricture are a slight urethral discharge and pain in the canal behind the seat of the stricture at the time of micturition. The stream of urine does not pass in its ordinary form, but is flattened or twisted, and as the disease advances it becomes smaller, and ultimately the fluid may only be discharged in drops. The straining efforts to discharge the urine often induce tenesmus. As the case advances the urine becomes alkaline and ropy, and deposits a precipitate when allowed to stand. Attacks of complete retention of urine occur with increasing frequency. But these symptoms are not in themselves sufficient to establish the presence of stricture. It is necessary to examine the urethral canal with a catheter or bougie to ascertain whether an organic obstruction exists, whether one or more strictures are present, and their calibre. The treatment of organic stricture is chiefly mechanical. It is sufficient to restore the natural calibre of the canal so far as this can be safely effected, and to maintain this patency after it has been established. Spasmodic stricture usually occurs as a complication of organic stricture or of inflammation of the mucous membrane, but may arise from an acrid condition of the urine, from the administration of cantharides, turpentine, etc., and from the voluntary retention of urine for too long a time. The treatment consists in the removal of the causes as far as possible and the use of a hot bath. The inhalation of chloroform sometimes gives immediate relief. Inflammatory or congestive stricture commonly arises when a recent purulent discharge from the urethra has been checked by external cold or wet. The treatment is much the same as that for retention of urine. Consult Rowlands, R. P., 'The Operations of Surgery' (New York 1915).

STRIFE, by John Galsworthy. Nothing is more striking in Galsworthy's work as a dramatist than the skill with which he combines the functions of the artist and the social critic without prejudice to either. In all but two of his plays he has chosen for his theme some one of the outstanding problems of modern social organization and clothed it in dramatic form of compelling interest. In 'Strife' it is the conflict between capital and labor as exemplified in a prolonged strike at the Trenartha Tin Works. The directors of the company have been summoned down from London for a conference with the men and the action takes place during a single afternoon. The company is losing money; the men and their families are starving; both are ready to come to terms but their indomitable leaders, old John Anthony, founder and president of the company, and David Roberts of the workmen's committee, will not hear of compromise. Both men are fighters and both are fighting for a principle; it is a clear-cut «conflict of wills» such as few dramas present. When Anthony talks to his frightened directors we feel that nothing can balk that iron will. But Roberts' passionate appeal to his fellow workers to hold out in order that their sacrifices and suffering shall not be in vain is still more moving and no less forceful. Although the struggle finally ends in compromise between employers and men, the tense emotional interest is maintained to the very end. Roberts comes from the death bed of his wife to fling defiance at the board only to learn that the agreement has just been signed, and he and Anthony face defeat together with a like scorn of their weaker followers and a reluctant sympathy and respect for each other. While these two are the chief protagonists, Galsworthy uses no less than 30 speaking parts to fill in his picture and at least half of these are clearly defined individual characters, yet his canvas is neither crowded nor confused. This is largely due to his masterly command of natural and characteristic dialogue. His personages are never mere mouthpieces for his own ideas but speak their own thoughts in their own language.

An interesting comparison suggests itself with certain plays of other nationalities based on the same theme, such as Björnson's ‘Beyond Human Power,’ Hauptmann's, ‘The Weavers,’ Bergstrom's, ‘Lyngaard & Co.,’ Mirbeau's, ‘Les Mauvais Bergers.’ Lack of space forbids comparison in detail but it is noticeable that all these plays culminate in a scene of mob violence whereas Galsworthy achieves the effect of violent emotion and strained nerves by more subtle means.

‘Strife’ was first produced in a series of matinees at the Duke of York's Theatre in London in March, 1909. The first American production took place at the New Theatre, New York, in November of the same year.

Grace R. Robinson.

STRIGES, the suborder containing the owls, the typical family of which is *Strigidæ*. See Owls.

STRIKE. See Dip.

STRIKES AND LOCKOUTS. A strike is a cessation of work on the part of workingmen to enforce their demands against the employer or to resist demands and rules made by the employer; a lockout is a cessation of work on the employer's initiative to enforce demands against his employees. Strikes are essentially a feature of the modern industrial organization; they developed gradually with the progress of industry and organization by unions of workingmen, reaching their height in the 19th century; the largest and most important strikes having occurred since 1870. While it is true that strikes have increased as the modern labor union has grown, yet it is also true that many strikes occur in unorganized or poorly organized industries; and it has usually been true that a young organization is much more apt to enter upon strikes as a means of testing its strength and enforcing its demands than an old organization. The older and stronger a labor union grows, as a rule, the more conservative it is in regard to strikes, and the less likely to order a strike for petty and insufficient cause. Nevertheless strikes are a recognized and important part of trade union policy. They are defended by trade unions on the following grounds; they are absolutely the only means which labor has of enforcing its demands in case argument and arbitration fail and afford the most practical means of controlling the supply of labor for the benefit of labor; whether a strike succeeds or not it attracts public attention to the question at issue and may lead to the satisfactory solution by the pressure of public opinion; they mark the line beyond which labor will not be forced in the reduction of wages or enforcement of unjust demands; the very possibility of a strike which inflicts an injury that the employer desires to avoid often prevents the attempt to enforce demands which employers know would be unwelcome to labor. The more radical view of a strike is based on the doctrine that the interests of labor and capital are necessarily antagonistic; that a strike, therefore, is an attempt to advance the interests of labor as against those of capital and is from labor's point of view entirely right and justifiable; it is a sort of advance skirmish in the war of interests between labor and capital and useful as winning some definite advantage to labor or of proving the strength and vitality of the labor movement and inflicting a more or less serious injury on capital. Against the policy of strikes it is urged that they cause heavy loss to both the labor and capital lying idle; that with their modern magnitude they seriously affect the whole industrial life and inflict an injury upon the general public; and that the points gained by labor are not commensurate with the cost of the strike. It must be remembered, however, that a strike is essentially a war and that many of the evils of war attend it; whereas if it be based upon a principle of justice it can be defended upon the same grounds as a war.

Causes of Strikes.— The chief causes of strikes are centred about the wage question; the largest number of strikes in the decade of 1881–1900 were for increase of wages; other important causes are for reduction of hours, against reduction of wages, for the recognition of the union and for the enforcement of union rules. The following statistics are taken from the report of the United States Bureau of Labor Statistics:

Leading Causes of Strikes.

Cause	1915	1916
Increase of wages	355	1,031
Increase of wages and reduction of hours	156	374
Reduction of hours	73	107
Against reduction of wages	32	97
Sympathetic	16	32
For union recognition	66	257
For increase of wages and recognition of union	28	119
Recognition, wages and hours	11	68
Discharge of employees	67	121
Employment of non-unionmen	55	70
General conditions	37	55
Miscellaneous	634	826
Totals	1,420	3,157

Of the above strikes, 15 in 1915, lasted over 200 days and 16 in 1916. In 1915 24 lasted 92 to 199 days and 79 in 1916. In 1915 48 lasted 50 to 91 days and 106 in 1916; while in 1915 74 lasted 25 to 49 days and 182 in 1916. The lockouts in 1915 totaled 173 and in 1916, 108. The States most affected by the disturbances in these years were New York, Pennsylvania, Massachusetts, Ohio, New Jersey, Illinois and Connecticut in the order named. The trades most affected were metals, mining, building, textiles, transportation and clothing.

Sympathetic Strikes.— The sympathetic strike is one undertaken by a body of workmen who have no special grievance of their own, in behalf of another body of workers on strike. It developed about 1880 and was based upon the workingman's recognition of the principle of the «solidarity of labor»; the principle that labor's interest are everywhere essentially the same and that an injury to one is an injury to all. The sympathetic strike is usually undertaken by workingmen employed by the same employer as the original strikers; or against an employer in some direct relationship with the employer of the original strikers, as competitor, buyer or seller or co-operating. In this way their action has direct economic effect on the question at issue, as well as the more general and less tangible effect of «sympathy.» Sympathetic strikes involve the dangers of violence and the weakening of a powerful organization, by the keeping idle of a body of men not so closely bound together nor so individually interested as if the strike directly concerned their personal welfare. Nevertheless, the mere fact that sympathetic strikes are undertaken is a proof of the development to some extent of a more enlightened and far-seeing self-interest, which often amounts to altruism, among workingmen. In connection with sympathetic strikes, the question of the universal strike may be mentioned; a universal strike in all departments of industry to obtain some special demand is naturally the logical development of the sympathetic strike. The universal strike has never been a problem for serious consideration in the United States; but on the Continent, where the labor movement is largely directed by the Socialists, it has been frequently agitated, especially in France; and was used as a powerful weapon in Belgium in 1893 to force the government to the adoption of the principle of universal suffrage.

Methods of Conducting a Strike; Picketing, etc.— The ordinary method of beginning or «ordering» a strike is by vote of those who are concerned; in the case of organized labor, the matter is usually referred to the national officers for an attempt at settlement, or approval of the action of the strikers, the latter securing the support of the whole organization. Often in large strikes, or in the case of partially organized industry appeal for financial aid and moral support is made to labor in general or to some large general organization like the Federation of Labor. The interest of the strikers is kept up and public interest aroused by meetings, speeches and the circulation of literature. The most important consideration is to prevent the «breaking» of the strike either by defections from the ranks of the strikers or by the bringing in of more workmen to take their places. The method generally adopted to prevent the latter is known as picketing, that is, the placing of some men near the establishment involved in a strike to speak to any who may come to take the strikers' places and to dissuade them from so doing. This has led often to threats and intimidation on the part of the pickets; and sometimes to violence. The result has been that the tendency of judicial decisions is to declare picketing illegal, or to so strictly limit the rights of the pickets as to make their work practically useless; a few States have declared picketing illegal by statute. Another method of preventing workmen from taking strikers' places is by large general meetings near the establishment involved, or at the place where workmen are brought into the town; this, however, is a more dangerous method than picketing, as it is often the means of collecting a large and irresponsible crowd, quite beyond the control of the leaders of the strike. Violence in a strike probably works more harm to the strikers than to any other thing; it arrays public opinion against them and brings against them the forces of government and the military. Trades unionists everywhere recognize this fact and invariably denounce violence whenever it occurs; the violence is often committed by persons having nothing to do with the strike, but taking the opportunity to do mischief and when committed by the strikers has not the approval of organized labor. It is often charged that strikers have sometimes been provoked to violence by agents of the employers in order to give better cause for breaking the strike; such charges are difficult to prove, but it is generally the opinion that such cases have occurred in the coal fields at least, if not elsewhere. One of the methods of fighting a strike is the injunction. The first time the injunction was of marked importance was in the Pullman strike of 1894, when the officers of the American Railway Union were enjoined not only from threats, intimidation and encouraging violence, but also from aiding or «persuading» any persons to strike. Injunctions since then have been frequently used and are often very severe against the strikers; the terms of most sweeping injunctions, however, have usually been changed in favor of the workingmen if the matter was brought into court by the strikers.

History and Statistics.— The first strike on record in the United States is that of the bakers in New York in 1741; the strikers were brought before the court on a charge of «conspiracy,» but not convicted; the shoemakers of Philadelphia struck for increase of wages in 1792 and three times subsequently before 1800 and were in every case successful; in 1805 the shoemakers again on strike were convicted in court on a charge of forming a «combination to raise wages,» and were fined eight dollars a head. Up to the Civil War strikes were comparatively few and small in extent; they were mostly for increase of wages or reduction of hours. After the Civil War the strikes increased in number and in importance; in 1872 occurred a succession of strikes in the building trades for the eight-hour day, which were mostly successful. In 1877 was the great railroad strike, begun by the firemen of the Baltimore and Ohio against a reduction of wages; it spread to the Pennsylvania, the Erie, the Lake Shore and numerous other important railroads and involved a large amount of violence and bloodshed, particularly in the region about Pittsburgh. Numerous strikes have taken place in the coal fields and have as a rule been attended with more or less bloodshed; though many have failed, some have been successful and the miners have gained some important points. Prominent among the coal strikes are those in the bituminous coal fields in 1894 and 1897, the latter resulting in a fairly satisfactory wage scale; and those in the anthracite coal fields of 1900 and 1902, that of 1902 threatening a coal famine and being adjusted by a commission appointed by the President of the United States. Among other noted strikes was that at Homestead in 1892 and the Pullman strike of 1894; the latter was a sympathetic strike undertaken by the American Railway Union in behalf of the employees of the Pullman Company, their purpose being to boycott the Pullman cars and prevent the railroads from hauling them; traffic was seriously delayed and considerable violence occurred, especially in Chicago; the national troops were brought into use by President Cleveland, though against the protests of the governors of Illinois and other States. The injunction, before mentioned, caused the imprisonment of the president and other officers of the American Railway Union, and the strike was a failure, though for the first few days it promised success.

The statistics of strikes for 1881–1900 show that there were 22,793 strikes, involving 117,509 establishments and 6,105,694 workingmen; of this number 50.77 per cent were successful; 13.04 per cent partially so, and 36.19 per cent failed. The greatest per cent of strikes which were successful were for reduction of hours, overtime pay, etc., 59.3 per cent; 53.2 per cent of those for increase of wages were successful and 18.2 per cent partially so; and 50.8 per cent of those for recognition of the union were successful. The statistics of lockouts show 42.93 per cent successful and 6.28 per cent partially so.

The first decade of the present century was marked in the United States by many strikes for the reduction of hours. Eight hours had become customary in many trades and those unions not enjoying it made concerted efforts to attain shorter hours and generally won. Among the most severe and protracted of these strikes was that of the International Typographical Union and affiliated organizations in the printing trade in 1906. This was bitterly fought in every large city in the country and was not entirely won for two or three years. The losses to the employers, unions and the public, both direct and indirect, were estimated at $25,000,000. As a result the Printers' League was organized by employers in the book, job and publication branch of the industry and this body, together with the American Newspaper Publishers' Association, has since endeavored to settle all difficulties by arbitration and largely succeeded.

The railroad trainmen were among the last to secure eight hours, the companies contending that the character of railway work was such that men had to continue until the trains arrived at destinations, so no hour schedule was possible. The men demanded overtime rates for work beyond eight hours and a nationwide strike was called for 4 Sept. 1916. At the time the railways were glutted with business and obviously a prolonged railroad strike meant paralysis to more than half the industries of the country, and lack of both food and fuel in many places. President Wilson demanded Congressional legislation to meet the situation and the Adamson Eight-Hour Act was rushed through and put into effect 1 Jan. 1917.

The War Situation.— In 1917 there were numerous demands made on employers for higher wages, growing out of the presumed great profits of manufacturers working on war orders. The strikes were mostly settled by paying the wages demanded and rapid increases of wages followed. When America entered the war, the reduced number of workers enabled workmen in many instances to dictate their pay and this with a general understanding that strikes were unpatriotic, reduced the strike evil for the time being. Owing to the scarcity of domestic commodities, however, the advance in prices and consequent high cost of living, the demands on employers for increased wages became more urgent during 1919 and resulted in many serious strikes, lockouts and closing of factories. Arbitration in many cases was refused and the strike remedy unfortunately was resorted to with ever-increasing frequency. See AMERICAN FEDERATION OF LABOR; TRADE UNIONS.

STRINDBERG, strĭnd'bĕr'ĭg, **August**, Swedish novelist, dramatist and publicist: b. Stockholm, 22 Jan. 1849; d. Stockholm, 14 May 1912. In his autobiographical novel 'The Son of a Servant' he emphasizes the dual social nature of his origin and attempts to derive his conflicting and unstable position on many questions from it. His mother (d. 1862) was of the poorest classes, his father of middle-class business position (steamship agent, d. 1883). From earliest childhood his life was one long struggle with his associates, teachers, parents, friends and rivals, differing, however, from that of other persons in that the consciousness of struggle is always present in his work; he never for a moment pretends that life is anything else. After passing through a number of parochial and preparatory schools, the tortures of which he has described in 'The Son of a Servant,' he went to the University of Upsala in 1870, where his experiences were not less unpleasant. 'I Rom' (In Rome) is a tragedy of this year, dealing with the experiences of the sculptor Thorvaldsen. 'Den fredlöse' (1871) is a one-act tragedy with a viking subject, in saga language. His first important play, written after Strindberg had turned to literature and left the university (1872), is 'Master Olof' (English trans., New York 1915), a prose drama of the Swedish Reformation (a version in verse was written 1878), full of youthful rebellion and pessimism. The play was written in the skerries of the Swedish Baltic, which were to remain for many years a source of stimulus and inspiration to Strindberg. A collection of sketches of student life at the university 'Fran Fjärdingen och Svartbäcken' (1877) is realistic and boisterous to the extreme, qualities which are emphasized in Strindberg's great satirical novel on all of Swedish society, 'The Red Room' (1879, English trans., New York 1913), which with all its intimate warmth of narration, remains an icy and supercilious tirade of scepticism, doubt, agnosticism. 'Nya Riket' ('The New Kingdom' 1881) is a criticism of Swedish social life after the parliamentary reforms of 1865. From 1880 to 1885, much of which period he spent in Switzerland, Strindberg was active as a Socialist of revolutionary tendencies; the most striking expressions of this attitude are his collection of propagandist material called 'Upper and Lower Class' (written 1880, first published 1884), and the four short stories published under the title 'Utopier i Verkligheten' ('Utopias on Earth,' 1885). 'Samvetskval' ('Pangs of Conscience'; two translations, Chicago 1915, and New York, in *The Call,* 1916) is the best of the latter; it is a powerful anti-militaristic tale of the Franco-Prussian War of 1870. His writings after that period display a growing conservative, even, on occasion, fanatically reactionary tendency. This evinced itself in his violent hatred of women, in general, although he was by no means inaccessible to their charms, and, toward the end of his life, in a predilection for mystical and occult study, and for mystic and supernatural elements in his later plays. In 1885, when he published the 30 short stories known as 'Married' (English trans., New York 1912), his attitude toward women was not that of the misogynist, although his introduction to the collection indicated his belief that the economic and social conditions of the age were constantly driving women into a more and more selfish and immoral position. His most delicate and human touches are to be found in this collection. In the dramas written about 1890, misogyny is already a dangerous obsession with Strindberg, leading him to produce such impressive perversions as the dramas 'The Father,' 'Countess Julia,' 'Creditors.' By 1890, Strindberg had completely passed out of his socialistic stage and into that of anarchic individualism, strongly influenced by Nietzsche. In that year appeared his novel of fishermen's life: 'I hafsbandet' (two English translations: 'By the Open Sea,' New York 1913; 'On the Seaboard,' Cincinnati 1913), in which the hostility between the educated and the lower classes is concentrated into a conflict with a tragic outcome, the woman taking the side of the lower classes against the intellectual aristocrat.

Throughout his life Strindberg was a diligent scholar and undertook painstaking, though not always original research in many fields, particularly Kulturgeschichte, philology, chemistry, sociology and ethnology. His great historic work on the history of the Swedish people ('Svenska Folket') appeared in 1880 and the studies for it are the basis of the collection of historical short stories 'Svenska Öden och Äventyr' (1880–90) and of a long series of historical dramas: 'Folkungasaga,' 'Gustaf Vasa,' 'Erik XIV,' 'Gustaf Adolf,' 'Charles XII,' 'Engelbrekt,' 'Christina,' 'Gustaf III,' etc. His last plays were peculiarly resigned and gloomy studies of city life: 'Oväder,' 'Brända Tomten,' 'Spöksonaten,' 'Pelikanen' (all 1907); 'Stora landsvägen' (1909). He attempted to gather all his disjointed opinions, in short articles of a page or two each, with strong reminiscences of Swedenborg, Goethe, Peladan and others, in the 'Blue Books' (1907, 1908, 1912), selections from which will be found in 'Zones of the Spirit' (New York 1913). Strindberg was thrice married: his first wife was the Swedish actress, Siri von Essen (married 1878; d. 1912; divorced in the '80's); his second wife was the Austrian authoress, Frida Uhl (married 1893; divorced 1896); his third wife was the Swedish actress, Harriet Bosse (married 1901; divorced 1904). Three children also survive him. (See FATHER, THE). Works not already mentioned and collected editions include 'Samlade Skrifter,' ed. Landquist, thus far 55 vols. (Stockholm 1912–18); 'Schriften,' trans. by Schering, thus far 30 vols. (Munich 1906–14); 'Plays,' trans. by Björkman, thus far four vols. (New York 1912–16); 'Easter and Stories,' (Cincinnati 1912); 'In Midsummer Days and Other Tales' (New York 1913); 'The Inferno' (New York 1913); 'The Growth of a Soul' (New York 1913); 'Historical Miniatures' (New York 1913); 'Advent' (Boston 1915). Consult Lind-af-Hageby, L., 'August Strindberg, the Spirit of Revolt' (New York 1913); Björkman, E., 'Voices of To-Morrow' (New York 1912); Esswein, H., 'August Strindberg' (Munich 1908); Paul, Ad., 'Strindberg-Erinnerungen und Briefe' (Munich 1914); 'En Bok om Strindberg' (Karlstad 1894); Uddgren, G., 'Boken om Strindberg' (Gothenburg 1909); Uddgren, G., 'En ny bok om Strindberg' (Gothenburg 1912); Zetterlund, R., 'Bibliografiska Anteckningar om August Strindberg' (a good bibliography, Stockholm 1913).

JACOB WITTMER HARTMANN.

STRINGHAM, string'am, **Silas Horton,** American naval officer: b. Middletown, N. Y., 7 Nov. 1798; d. 1876. He joined the United States navy in 1809 and served on the frigate *President.* He was promoted lieutenant in December 1814; served on the schooner *Spark* in the Mediterranean Sea in 1815–18; and took part in the war with Algiers. In 1821–24 he was executive officer on the *Hornet* in the West Indies. He was promoted captain in 1841; he served on the *Ohio* during the bombardment of Vera Cruz in 1847. On the opening of the Civil War in the United States he was appointed flag officer of the North Atlantic blocking squadron and was at the capture of the forts on Hatteras Inlet. He was relieved of his command in the fall of 1861 and the following year was made a rear-admiral.

STRIPED BASS, STRIPED SKUNK, STRIPED SQUIRREL, STRIPED SNAKE, etc. See BASS; SKUNK; SQUIRREL; GARTER SNAKE.

STROEBEL, stre'bl, **Edward Henry,** American diplomat: b. Charleston, S. C., 7 Dec. 1855; d. Bangkok, Siam, 15 Jan. 1908. He was graduated from Harvard in 1877 and from Harvard Law School in 1882 and after practising in New York (1883–85) was secretary of the United States legation at Madrid in 1885–90. He was third assistant secretary of state April 1893, April 1904, Minister to Ecuador April to December 1894, and to Chile 1894–97, and in 1899 was appointed counsel for Chile before the United States and Chilean Claim Commission. From 1898–1906 he was Bemis professor of international law at Harvard. He was granted leave of absence by the University in 1903 to become general adviser to the Siamese government and in 1906 resigned from the university to become permanent adviser. Among his published writings is 'The Spanish Revolution' (1898).

STROMBOLI, strŏm'bŏ-lē, an island of the Lipari or Æolian group, in the Mediterranean Sea, off the northern coast of Sicily. It consists of a lofty volcano, whose cone rises to a height of 3,022 feet and is in constant activity. It was believed by the ancients to be the abode of Vulcan and in mediæval times the entrance to purgatory. The island is fertile and its chief products are cotton, wine, figs and other fruits belonging to this region. It yields besides, sulphur and pumice stone and possesses warm mineral springs.

STROMEYERITE, an ore consisting of sulphides of silver and copper in somewhat variable proportions, occurring in some of the mines of the far West.

STRONG, Augustus Hopkins, American theologian: b. Rochester, N. Y., 3 Aug. 1836. He was graduated at Yale in 1857 and was Baptist clergyman at Haverhill, Mass. (1861–65) and Cleveland, Ohio (1865–72). He was president and professor of biblical theology at the Rochester Theological Seminary (1872–1912). He has written 'Systematic Theology'; 'Philosophy and Religion' and 'The Great Poets and Their Theology,' 'Christ in Creation and Ethical Monism,' 'Popular Lectures on the Books of the New Testament.'

STRONG, Caleb, American statesman: b. Northampton, Mass., 9 Jan. 1745: d. there, 7 Nov. 1819. He was graduated at Harvard College in 1764, studied law and was admitted to the bar in 1772. During the Revolution he was a member of the general court or legislature and of the Northampton committee of safety. For nearly 25 years after 1776 he was county attorney, in 1779 was a member of the State constitutional convention, and in 1780 of the State council, and several times represented his county in the State senate. In 1787 he was elected to the convention for framing a national constitution but was obliged by sickness in his family to return home before the completion of its labors; and in 1789 he was elected one of the first United States senators from Massachusetts, was re-elected in 1793 and resigned in 1796. From 1800 to 1807 he was governor of Massachusetts and again from 1812 to 1816. As a Federalist he was opposed to the war with England and he refused to comply with the President's order to call out the State militia on the plea that the governor alone had the right to decide whether or not the militia should be called out. Consult Alden Bradford's biography of him (1820).

STRONG, Frank, American educator: b. Venice, N. Y., 5 Aug. 1859. He was graduated at Yale in 1884 and was admitted to the bar in Rochester, N. Y., in 1886. Received degrees of A.M. and Ph.D. (Yale), 1893 and 1897, respectively. Received degree of LL.D., (Baker University, University of Oregon and Kansas State Agricultural College) 1910. He began the practice of law in Kansas City, Mo., but retired in 1888 to become principal of the high school at Saint Joseph, Mo. He was elected superintendent of schools at Lincoln, Neb., in 1892 and in 1897 was elected lecturer in history in Yale University. In 1899 he was made president of the University of Oregon and in 1902 returned to Kansas where he was called to the chancellorship of the State University. His published works include 'The Government of the American People' (1891); 'Life of Benjamin Franklin' (1898); 'Cromwell's West Indian Expedition' (1899); 'A Forgotten Danger to the New England Colonies' (1898); 'Annual Reports to the Board of Regents, University of Oregon' (1900–01); 'Annual Reports to the Board of Regents, University of Kansas' (1902–12); 'The Problem of Higher Education in States that Maintain more than One College or University' (Transactions and Proceedings of the National Association of State Universities, 1908); 'Report of Educational Progress During the Year' (Proceedings of the National Education Association, July 1910); 'Control and Management of Athletics' (Transactions and Proceedings of the National Association of State Universities, 1913); 'Imagination in College' (*The Nation*, 1 March 1914); 'Economy of Time in Education' (Journal of Proceedings and Addresses, National Education Association, 1914); 'The Opportunity of American Universities' (*School and Society*, June 1915); and 'Present Activities and Accomplishments of Higher Education' (*School and Society*, October 1915). Served as member of the National Council of Education of the National Education Association; president of the section of higher education of the National Education Association; president, Kansas State Teachers Association; and president of the National Association of State universities. He is a member of the State Board of Education of the State of Kansas and a member of the Board of Education of the Northern Baptist Convention, United States. The University of Kansas enlarged and developed under his administration, adding to its schools and divisions the Summer Session, the School of Medicine, the School of Education, the Extension Division, the Division of State Service Work, the Biological Survey, the Engineering Experiment Station, etc.

STRONG, George Crockett, American soldier: b. Stockbridge, Vt., 16 Oct. 1832; d. New York, 30 July 1863. He was graduated from the United States Military Academy in 1857, and in the Battle of Bull Run was ordnance officer on General McDowell's staff. In 1862 he was in command of an expedition from Ship Island to Biloxi, Miss., and the next year participated in the operations against Charleston, and in the two attacks on Fort Wagner. In the last he fell mortally wounded. Fort De Kalb on the Potomac was renamed Fort Strong in his honor. Author 'Cadet Life at West Point' (1862).

STRONG, James, American biblical scholar: b. New York, 14 Aug. 1822; d. Round Lake, N. Y., 2 Aug. 1894. He was graduated (1844) at Wesleyan University, Middletown, Conn., then taught ancient languages at Troy Conference Academy, West Poultney, Vt., for two years, when he went to Flushing, L. I., where he continued his biblical studies, but undertook commercial enterprises, such as building the Flushing Railroad, of which he became president. He became professor of biblical literature (1858–61) and acting president of Troy University. In 1868 he was made professor of exegetical theology at Drew Theological Seminary, Madison, N. J., but resigned on account of bad health 1893, and retired. He edited, in collaboration with Dr. McClintock 'The Cyclopædia of Biblical, Theological and Ecclesiastical Literature' (1867–85), continuing the work alone after the death of his co-worker. His 'Exhaustive Concordance of the Bible' (1894) was the outcome of the work of many years.

STRONG, Josiah, American clergyman: b. Naperville, Ill., 19 Jan. 1847; d. 28 April 1916. He was graduated at Western Reserve College in 1869, and studied at Lane Theological Seminary; was ordained in the Congregational Church, and held pastorates in Wyoming and Ohio; was secretary of the Evangelical Alliance for the United States in 1886–98. In the latter year he was made president of the League for Social Service. (Reorganized, 1902, as The American Institute of Social Service). President of Social Centre Association of America in 1911. His publications include 'Our Country' (1885); 'The New Era' (1893); 'The Twentieth Century City' (1898); 'Religious Movements for Social Betterments' (1900); 'Expansion' (1900); 'The Times and Young Men' (1901); 'The Next Great Awakening' (1902); 'The Challenge of the City' (1907); 'My Religion in Every Day Life' (1910); 'Our World; The New World-Life' (1913); 'Our World; The New World Religion' (1915). He was editor of 'Social Progress' (a year book) (1904–06); and edited *Gospel of the Kingdom,* a magazine, from 1908.

STRONG, Richard Pearson, American biologist: b. Fortress Monroe, Va., 18 March, 1872. He was graduated (1893) at Yale and received the M.D. diploma (1897) from Johns Hopkins. He was appointed (1899) president of the board for investigation of tropical diseases in the Philippines, and was director of the Government Biological Laboratory at Manila (1901–13), since which he has been professor of tropical medicine at Harvard. He was medical director of the International and American Red Cross Sanitary Commissions in Serbia in 1915, during the typhus epidemic.

STRONG, Sir Samuel Henry, Canadian jurist: b. Poole, Dorsetshire, England, 13 Aug. 1825; d. Ottawa, 21 Aug. 1909. He was taken to Canada in his 11th year by his father, who was appointed chaplain of the forces in Quebec and rector at Bytown (now Ottawa). He was educated at the Quebec High School, and under private tuition, taking later to law studies. In 1849 he was called to the Toronto bar, becoming partner with Sir Thomas W. Taylor (later chief justice of Manitoba), then with James David Edgar (later speaker of the Canadian House of Commons). Strong soon built up a high reputation, and was appointed (1856) on the commission for consolidating the statutes of Canada and Upper Canada. By 1869 he had risen to a position on the bench as a vice-chancellor of Ontario. He was member of the commission (1871) of enquiry into a union of the law and equity courts. He rose next (1874) to the Court of Error and Appeals of Ontario, then (1875) to the Supreme Court of Canada as puisne judge, becoming (1892) successor to Sir W. J. Ritchie as chief justice. He resigned from this post in 1902 to become chief of the commission for consolidating the statutes of Canada. He was one of Canada's ablest jurists.

STRONG, Theodore, American mathematician: b. South Hadley, Mass., 26 July 1790; d. New Brunswick, N. J., 1 Feb. 1869. He was graduated at Yale University in 1812; became professor of natural philosophy and mathematics at Hamilton College in 1816–27; and held a similar chair at Rutgers College in 1827–61. In the realm of pure mathematics he was conceded to have no superior. After the ablest mathematicians of Europe had failed to solve the irreducible case of cubic equations left by Cardan, he discovered its solution by a direct method. His publications include 'Notes on the Parallelogram of Forces and on Virtual Velocities' (1864); 'On the Integration of Differential Equations of the First Order and Higher Degrees' (1864); 'A New Theory of the First Principles of the Differential Calculus' (1865); 'A Treatise on Elementary and Higher Algebra' (1859); 'A Treatise on the Differential and Integral Calculus' (1869).

STRONG, William, American jurist: b. Somers, Conn., 6 May 1808; d. 1905. He was graduated (1828) at Yale, and taught at Burlington, N. J., while studying law under Garret D. Wall. He was admitted to the bar at Reading, Pa., in 1832 and started practice there where he rapidly advanced to prominent civic positions. He was elected to Congress in 1846 as a Democrat, re-elected in 1848 and declined nomination in 1850 to return to private practice. In 1857 he became justice of the Supreme Court of Pennsylvania for a 15-year term, serving only 11, and attaining very high repute as a jurist. President Grant appointed him (1870) justice of the United States Supreme Court.

STRONG, William L., American merchant and mayor of New York: b. on a farm in Richmond County, Ohio, 22 March 1827; d. New York 1900. He began life as dry goods clerk in Wooster, Ohio, spent 10 years in trade in Mansfield, Ohio, then came to New York in 1853. He commenced here as salesman for L. G. Wilson and Company, a dry goods commission house, where he learned every detail of the business, when his firm failed in the panic of 1857. He entered his services with Farnham, Dale and Company's dry goods store till 1869, when he started the next year his own business of W. L. Strong and Company, succeeding to the trade of Farnham, Dale and Company. Branches in Boston and Philadelphia grew up with his great business success. Strong was a Republican and took a general interest in public matters, refusing office, however, till his party combining with reform Democrats got him to be candidate (1894) for mayor and he was elected. He was the last mayor before the founding of Greater New York, and the 91st mayor of New York.

STRONTIANITE, native strontium carbonate, a mineral usually found massive with a crudely fibrous and radiating structure. It rarely occurs in perfectly developed, orthorhombic crystals simulating aragonite in form and twinning, spire-shaped, branching groups being the most common. It has good prismatic cleavage; is brittle, breaking with an uneven fracture; hardness 3.5 to 4; specific gravity 3.69; lustre vitreous; color usually yellowish-white, sometimes pale-greenish; streak white; transparent to translucent. Before the blowpipe it swells and sprouts, but fuses only on thin edges. It imparts to the flame the crimson color characteristic of strontium. Its name is due to its occurrence in Strontian, Scotland, but its most important locality is Hamm, Westphalia. It is found at Schoharie and elsewhere in New York. Celestite ($SrSO_4$) and strontianite are the minerals from which all of the strontium salts so valuable in sugar refining and in pyrotechnics are derived.

STROPHANTHUS, a genus of trees, shrubs or climbers, belonging to the family *Apocynaceæ*, and found in Asia and Africa, being chiefly tropical. The leaves are feather veined and opposite, and the cymose inflorescence is terminal. The flowers are handsome, ranging in color from white, through the yellows and reds, to purple. The calyces are glandular, the corollas funnel-shaped, with five lobes tapering into attenuated, long tails. The two carpeled ovaries develop into capsular fruits having two diverging free follicles, which enclose the hairy seeds. A climbing species (*S. hispidus*) has seeds which are hairy and have a plumose tuft of silky hairs attached to their apexes, by a slender filament and which contain a bitter, poisonous glucoside called strophanthin. This poison contracts the voluntary muscles, and is so deadly that an elephant wounded by the spiked and strophanthus-poisoned beams, which are hung for the purpose in the runs of the huge beasts, is unable, it has been stated, to go more than 10 miles from the spot. Species of Strophanthus, especially *S. hispidus*, are powerful ingredients of those African arrow-poisons called in West Africa inée, onaye or poison of Pahonias, and in East Africa, Kombé; while still another near Somaliland is known as wanika poison. Strophanthin is a valuable cardiac stimulant, and a drug employed in heart disease, similar in its effects to digitalis, slowing the heart's action, and increasing its contractility and the tension of the arteries, but is more rapid and uncertain in its effects than the other drug. Several species are known in gardens and greenhouses, one, *S. petersianus*, being remarkable for its octopus-like twisted corolla lobes, colored red and yellow.

STROPHE, strō'fē, the name of one of the divisions of a Greek choral ode. It is a designation also often applied to the stanza in modern poetry. The singing of the strophes on the stage was accompanied with a motion or turn from right to left toward the images of the gods placed on the sides of the orchestra (in the ancient sense of this word); but the singing of the antistrophe, with a contrary motion, from the left to the right. In a poetical sense the strophe designates a union of rhythmical periods corresponding closely to a following combination.

STROSSMAYER, strŏs'mī-ĕr, **Joseph Georg,** Hungarian bishop: b. Essek, Slavonia, 4 Feb. 1815; d. 1905. He was educated for the priesthood at the University of Budapest and at Vienna, and in 1849 was made bishop of the Croatian diocese of Diakovo. He was for many years the leader of the movement for the separate existence and self-government of Croatia, and was known as a zealous churchman. At the Vatican Council in 1870, he was the leader of the Opportunists, the party which opposed the declaration of the dogma of infallibility on the ground that the times were not rife for the definition. But when the Council declared it to be a formal article of faith, he acquiesced and subscribed to it.

STROTHER, stroth'ĕr, **David Hunter,** American author and artist: b. Martinsburg, Va., 16 Sept. 1816; d. Charleston, W. Va., 8 March 1888. Before the outhbreak of the Civil War his articles and illustrations of Southern life attracted wide attention, being especially noteworthy for their faithful presentation of Southern scenes and customs. He wrote under the nom de plume of «Porte Crayon,» in 1852, a series of humorous papers in *Harper's Magazine* which attracted considerable attention owing to the fact that they presented a new and sympathetic view of the Southern States of the United States. He served as colonel in the Union army during the Civil War, and was consul-general to Mexico (1879–85). His writings were collected in book form and published under the names of ‘The Blackwater Chronicle’ (1853); ‘Virginia Illustrated’ (1857).

STROUDSBURG, strowdz'bĕrg, Pa., borough, county-seat of Monroe County; on Broadhead Creek, and on the Delaware, Lackawanna and Western, and on the New York, Susquehanna and Western Railroads, about 25 miles north of Easton. It is in the Blue Ridge region, between the Delaware Water Gap and Mount Pocono. The climate, scenery, good water, and the good roads have made the place a favorite summer resort. There are public and private schools, and two national banks. Pop. about 5,000.

STROZZI, strŏt'sē, the name of a wealthy and illustrious Florentine family, which came into prominence about the end of the 13th century. Palla, Filippo and Piero were the three most renowned members of this princely house, between 1432 and 1537, who were either exiled or lost their lives in the struggle for liberty against the power of the Medici family. The Strozzi family engaged in banking and became very wealthy and their wealth continued to steadily increase. With this increase of wealth grew their influence in Southern Italy which is said to have been upheld by over 80 Strozzi wealthy families. Their power was finally overthrown by Cosmo I di Medici in 1537. Various representatives of the Strozzi family still live in Florence where the titled head of the house has been, since 1722, the Prince of Forano.

STROZZI, Bernardo (Il Prete Genovese, of Il Cappucino), Italian painter: b. Genoa, 1581; d. Venice, 1644. He painted in the naturalistic style of Caravaggio, and produced many frescoes and easel pictures in oils. They are all of a somewhat crude character, and fiery coloring, though the design is strong.

STRUCTURAL GEOLOGY, that branch of geology that treats of the architecture of the earth's crust. See Fault; Folds; Mountains; Unconformist; also section on *Structural Geology* in article on Geology.

STRUCTURAL SHAPES. See Rails and Structural Shapes, Manufacture of.

STRUCTURAL STEEL. See Rails and Structural Shapes, Manufacture of; Steel — The Evolution of Steel Making Processes.

STRUENSEE, stroo'ĕn-zā, **Count Johann Friedrich von,** Danish statesman and philosopher; b. Saxony, 5 Aug. 1737; d. 28 April 1772. He studied medicine, and in 1768 was appointed physician to the king of Denmark. He soon became a favorite, and effected the dismissal of all those who were obstacles to his own ambitious plans. In 1770 he advised the king to abolish the council of state, and to establish the ancient royal power lost through the rise of the nobles to influence in 1660, a measure which roused the indignation of the Danish nobility. Struensee, by various means, gradually usurped the administration of all affairs in the name of the king, and caused himself to be created count. The king, Christian VII, a feeble-minded nonentity, was completely under his domination and that of the ambitious queen, who appears to have been in love with Struensee. Between them they appointed new ministers and proceeded to run the affairs of state. An alliance was formed with Sweden in opposition to the Russian influence that had previously been all powerful at the Danish court. Struensee appears to have been, under the guise of an autocrat, very much of a liberal. He mitigated the penal laws, greatly reduced the extent of serfdom and encouraged free industry and trade in opposition to the monopolies that had previously prevailed. This angered the clergy and the nobles who organized a conspiracy against him, and on 16 Jan. 1772, Struensee was seized, found guilty of criminal relations with the queen, convicted and executed.

STRUNSKY, strŭn'skĭ, **Simeon,** American author: b. Vitebsk, Russia, 23 July 1879. He was educated at Horace Mann High School, New York, and was graduated (1900) at Columbia. He was (1900–06) a department editor of the New International Encyclopædia, from 1906–13 he was editorial writer, becoming literary editor of the *New York Evening Post* (1913–14). He wrote ‘The Patient Observer’ (1911); ‘Through the Outlooking Glass with Theodore Roosevelt’ (1912), an amusing parody; ‘Post-Impressions’ (1914); ‘Belshazzar Court, or Village Life in New York City’ (1914); ‘Post-Impressions’ (1914). Most of his writings, including the above are in essay form, and are marked by good-humored satire and shrewd wit which make them entertaining reading.

STRUT, *in architecture,* a brace or support, either upright, horizontal or diagonal. The struts of a roof extend obliquely from a rafter to an upright post. Diagonal struts are frequently used in gates, doors and between joists.

STRUTHIONIDÆ, the ostriches and related ratite birds. See Ostrich.

STRUTT, strŭt, **Joseph,** English antiquary: b. Chelmsford, 27 Oct. 1749; d. London, 16 Oct. 1802. He was articled to W. W. Ryland, the engraver, studied engraving and painting and obtained the gold and silver medals of the Royal Academy. Later he devoted most of his time to research work in the British Museum. In 1773 he published his ‘Regal and Ecclesiastical Antiquities from Edward the Confessor to Henry VIII’ and shortly afterward his ‘Horda Angel-Cynnan, or Manners, Customs, etc., of the English’ (1774–76). His other works include a ‘Chronicle of England’ (1777–78); ‘Biographical Dictionary of Engravers’ (1785–86); ‘Dresses and Habits of the People of England,’ etc. (1796–99); and ‘Sports and Pastimes of the People of England’ (1801). He left some manuscripts, from which were afterward published his ‘Queenhoo-Hall,’ a romance, concluded by Sir Walter Scott; ‘Ancient Times,’ a drama; also ‘The Test of Guilt, or Traits of Ancient Superstitution,’ a tale. His literary work and researches had considerable influence on Scott's ‘Waverly’ novels.

STRUVE, stroo'fĕ, **Friedrich Georg Wilhelm von,** Russian-German astronomer: b. Altona, 15 April 1793; d. 23 Nov. 1864. In 1813 he entered the Dorpat observatory, and was appointed director in 1817. On the completion of the Russian observatory at Pulkova, near Saint Petersburg, in 1839, he was nominated its director, and here he continued his researches on nebulæ and double stars. From 1816 to 1819 he was engaged on the triangulation of Livonia, and from 1830 to 1845 he was connected with the measurement of the arc of the meridian in the Baltic provinces, which was afterward extended to the Arctic Ocean and the Danube. Among his published works are ‘Observationes Dorpatenses’ (1817–39); ‘Catalogus Novus Stellarum Duplicium et Multiplicium’ (1827); ‘Stellarum Duplicium et Multiplicium Memsuræ Micrometricæ’ (1837); ‘Etudes d'astronomie · Stellaire’ (1847); ‘Stellarum Fixarum Imprimis Duplicium et Multiplicium Positiones Mediæ’ (1852); ‘Arc du Méridien de 25° 20′ entre le Danube et la mer glaciale’ (1857–60).

STRUVE, Otto Wilhelm von, Russian astronomer: b. 7 May 1819; d. 1905. He early studied at the Dorpat and Pulkova observatories, and on the death of his father, Friedrich-Georg Wilhelm von Struve (q.v.) he succeeded him as director of the great Pulkova observatory near Saint Petersburg. His work was given mostly to the observation of double stars, and continuing the organization and administration of the observatory founded by his father. He is credited with having discovered 500 binary stars in his examination of the northern heavens alone. He also discovered new principles in star measurement and phenomena and made interesting and valuable observations respecting the mass of Neptune, the dimensions of the ring of Saturn, solar velocity and corona extent. His published books, apart from the 14 volumes of ‘Observations de Pulkova’ which he edited, are to be found in technical journals devoted to his special field of work. He was the presiding officer of the International Astrophotographic Congress at Paris in 1877. In 1890 he resigned the directorship at Pulkova and retired to Karlsruhe.

STRYCHNINE, strĭk'nĭn, (Latin *strychnos,* from Greek of same form) $C_{21}H_{22}N_2O_2$, an alkaloid existing in the seeds of the Strychnos Nux-vomica, Saint Ignatius bean, and the other species of Strychnos. The Strychnos Nux-vomica is a tree of medium size growing in the East Indies. It bears a pulpy fruit about the size of an orange, containing the large seeds that are the drug nux-vomica. These seeds are circular, about three quarters of an inch in diameter, an eighth of an inch thick, and very hard and horny. Rasped or filed they are used to kill cats, dogs, rats and vermin under the name of rats-bane or dog buttons. The active principle strychnine may be obtained by treating nux-vomica with alcohol containing a little sulphuric acid. This solution contains the strychnine as well as various coloring matters. From it the strychnine may be obtained in small white prismatic crystals, slightly soluble in water, giving it a bitter taste even in as dilute a solution as one part in 700,000. Strychnine is very poisonous, a small amount causing death with violent tetanic convulsions. It is, however, used extensively in very small doses in medicine, being valuable as a heart stimulant, and in cases of paralysis, nervous affections, dyspepsia, etc. It is a weak base forming salts with acids, The sulphuric acid salt or strychnia sulphate is used generally in place of the free alkaloid. Sulphuric acid and strychnine together form a colorless solution which is turned strongly violet by the addition of bichromate of potash. The purple rapidly changes into red and from that into yellow. See ALKALOIDS; TOXICOLOGY; BRUCINE.

STRYCHNOS, a genus of the family *Loganiaceæ,* represented by trees, shrubs or vines which climb by stiff hooked tendrils, and are mostly tropical. The leaves are opposite, thin or coriaceous, and prominently three to five-nerved. The flowers are small and whitish, collected in dense axillary or terminal cymes, and are salver-shaped, with five valvate lobes. The ovary is usually two-celled and develops into an indehiscent, globose berry with a hard rind and pulpy interior enclosing the seeds. This pulp is sometimes innocuous, and is eaten by birds and men, but the seeds are generally violently poisonous. Those of the Indian *Strychnos potatorum,* when rubbed in a vessel of water, send all the impurities to the bottom, whence the name of clearing-nut tree. Its pulp is edible. While many of the species of *Strychnos* contain the poisonous alkaloid called strychnine, which is used in small quantities as a valuable medicine, most strychnine of commerce is obtained from the button-like, satiny seeds of *S. nux-vomica,* or nux-vomica tree (q.v.), or from those of *S. ignatii,* the Saint Ignatius bean. Strychnine is also the sole active principle in *S. tieute,* from Java, being extracted from the bark by boiling, and employed by the Javanese for poisoning their arrows. *S. toxifera,* a woody climber often three inches thick, with hooked tendrils, and covered with dark-brown hairs, is found in South America, and, with other species, is supposed to be the source of the arrow poison called woorali or *curare.* This substance is black-brown, like an extract, or firmer, brittle and friable; it is used somewhat in medicine as a nervous sedative, and in physiological experiments. The South American Indians put it on arrows, chiefly on those shot from blow-guns, and use it for hunting, since the game is wholesome after being poisoned. Curare acts by paralyzing the terminals of the motor nerves, and causes death instantly when mixed with the blood, by paralyzing the muscles of the chest, and so suffocating the victim. The bark of *S. nux-vomica* was at one time introduced as a substitute for Angostura bark, with such deadly effect that the use of the latter was discontinued for a while. In Brazil, however, the cortex of *S. pseudo-quina* has been used as a febrifuge. *S. colubrina* furnishes the snakewood (q.v.).

STRYKER, strīker, **Melancthon Woolsey,** American college president: b. Vernon, N. Y., 7 Jan. 1851. He was graduated from Hamilton College, New York, in 1872 and from Auburn Theological Seminary in 1876. He held pastorates in the Presbyterian Church, 1876–83, in the Congregational Church, 1883–85, and again in the Presbyterian Church, 1885–92. From 1892–1917 he was president of Hamilton College. A student of hymnology he published, among others, the following hymns and poems; 'Song of Miriam' (1888); 'Church Song' hymnal (1889)'; 'Lattermath Verse' (1896); 'College Hymnal' (1897); 'Faculæ Annorum' (1917); and is author of 'Well by the Gate,' sermons (1903); 'Baccalaureate Sermons' (1905); 'English Bible Versions and Origins' (1915); 'Three Addresses on Lincoln' (1917).

STRYKER, William Scudder, American historian: b. Trenton, N. J., 6 June 1838; d. there, 29 Oct. 1900. He was graduated from Princeton in 1858, enlisted in the Union army and served on General Gillmore's staff in South Carolina; was returned north on account of ill-health, resigning his commission in 1866. He was adjutant-general of New Jersey from 1867 until his death. He published a 'Roster of Jerseymen in the Revolutionary War' (1872); a 'Roster of New Jersey Volunteers in the Civil War' (1876); and 'The Battles of Trenton and Princeton' (1898).

STUART, the name of a royal family of Scotland and England, also written Stewart and, less frequently, Steuart. The name is derived from the important office of steward of the royal household of Scotland. The founder of the house seems to have been a Norman baron named Alan (the son of Flaad) a follower of William the Conqueror, who obtained the lands and castle of Oswestry, in Shropshire. His second son, Walter, entered the service of David I of Scotland, by whom he was appointed dapifer, that is, meatbearer, or steward of the royal household. The steward obtained from David the lands of Renfrew, Paisley, Pollock, Cathcart, and others in that district; he founded the abbey of Paisley in 1160; and died in 1177. His grandson Walter held, in addition to the office of steward, that of Justiciary of Scotland. He died in 1246. His eldest son, Alexander, the 4th steward, seized the islands of Bute and Arran, in the right of his wife Jean, heiress of James, lord of Bute. This led to the expedition of Haco of Norway, and the battle of Largs (1263), in which the steward is said to have commanded the right wing of the Scots, greatly contributing to the defeat of the Norwegians. Alexander had two sons, **James**, the 5th steward, and **John**, known in history as that Sir John Steward of Bonkyl, or Bonkill, who was killed at the battle of Falkirk (22 July 1298). The eldest of Sir John's sons, **Alexander**, was the ancestor of the Stewart earls of Angus; the 2d **Alan**, of the Stewart earls and dukes of Lennox; the 3d, Walter, of the earls of Galloway; the 4th, of the earls of Athol, Buchan and Traquair and the Lords Lorn and Innermeath. James, the elder brother of Sir John, succeeded as 5th steward in 1283. Three years later, on the death of Alexander III he was chosen one of the regents of the kingdom. He fought bravely under Wallace for some time, but submitted to Edward I in 1297. In spite of the most solemn oaths which the English king obliged him to take, he died in the service of Bruce in 1309. His son, **Walter**, the 6th steward, had an important command in the Seztch army at Bannockburn. Some time after, King Robert bestowed the hand of his daughter Marjory upon him, a union which brought the crown of Scotland, and eventually that of Great Britain into his family. Walter was succeeded by his son, **Robert**, the 7th steward. During the long and disastrous reign of David II, the steward distinguished himself by his patriotic exertions for the defense of Scotland, defeating the intrigues of that prince and Edward III to seat Lionel, Duke of Clarence, on the Scottish throne. On the death of David, without issue, the steward peacefully succeeded to the crown as Robert II in 1371, and died in 1390. From this time to the death of James V in 1542 the crown of Scotland remained in the direct male line of Stuarts, passing in unbroken succession from father to son. James V left a daughter Mary who succeeded to the throne. Her son, James VI of Scotland, succeeded to the English throne on the death of Elizabeth, tracing his claim through his great-grandmother Margaret, a daughter of Henry VII of England. The Stuarts were driven from England in the person of James II in 1688. (See for the history of the royal line, **Robert** II and III; **James** I, II, III, IV, V; **Mary Stuart**; **James** I (of England); **Charles** I and II; **James** II; **William** and **Mary**, and **Anne**). James II of England was twice married, first to Anne Hyde, daughter of Lord Clarendon, by whom he had Mary, queen of William III, and Anne, both of whom died leaving no issue. His second wife, Mary of Modena, gave birth, on the eve of the revolution, to James Edward Francis, Prince of Wales, commonly called the Old Pretender, or the Chevalier St. George. The legitimacy of this prince was long doubted; a great majority of the nation was convinced that the queen had never given birth to a child; but that there was no imposture is now a matter of historical belief. On the outbreak of the revolution, the queen and her infant son took refuge in France, and on the death of the ex-king, Louis recognized the child as king of England by the title of James III. In 1715 an unsuccessful attempt was made to seat him on the throne of his ancestors by force of arms. James Edward, who had landed in Scotland after his cause had been irretrievably lost, succeeded in making his escape. France, however, no longer offered him an asylum, as the Regent Orleans wished to stand well with the English government, and the Pretender went to Rome, where he lived in obscurity until his death in 1766. In 1720 he married the Princess Maria Clementina Sobieski, granddaughter of John Sobieski (q.v.), king of Poland, one of the wealthiest heiresses in Europe, by whom he had two sons, Charles Edward Louis Casimir (see **Charles Edward Stuart**), and Henry Benedict Maria Clement, born at Rome in 1725. In 1745, when the last effort was made for the restoration of his family, Henry Benedict assumed the command of the troops assembled at Dunkirk to aid the operations of his brother in Britain, but the news of the battle of Culloden prevented the embarkation of this armament, and Prince Henry returned to Rome. He took holy orders, and in 1747 was raised by Benedict XIV to the purple. On the death of his brother in 1788, he assumed the barren title of Henry IX, king of England. When the French conquered Italy he was obliged to flee to Venice, where, stripped of his bishoprics and rich church livings, he lived in great poverty until George III settled on him a pension of £4,000, which he enjoyed till his death in 1807. Next to the children of James II in representation of the royal Stuart family, come the descendants of Henrietta Maria, daughter of Charles I, and wife of Philippe, duke of Orleans, brother of Louis XIV of France. This princess gave birth to two daughters, Mary, who married Charles II of Spain, but had no issue, and Anna Maria, wife of Victor Amadeus, king of Sardinia.

The present representative of this line is Archduchess Maria Theresa of Austria-Este of the branch of Modena, wife of ex-King Ludwig III of Bavaria, eldest son of the regent Luitpold (d. 12 Dec. 1912). The present royal family of Great Britain trace their descent through Sophia, electress of Hanover, granddaughter of James I, by her mother Elizabeth, electress palatine, and queen of Bohemia. George V derives his descent from the electress Sophia through George I, George II, Frederick, Prince of Wales, George III, Edward, Duke of Kent, Queen Victoria and Edward VII. Consult Cowan, S., 'The Royal House of Stuart from its Origin to the Accession of the House of Hanover' (2 vols., London 1908).

STUART, Arabella, commonly called the **Lady Arabella**: b. Chatsworth, 1575; d. London, 27 Sept. 1615. This unhappy and innocent victim of jealousy and state policy was the only child of Charles Stuart, Earl of Lennox, younger brother to Henry Lord Darnley, the husband of Mary Queen of Scots. She was, therefore, cousin-german to James I, to whom, previously to his having issue, she was next in the line of succession to the crown of England, being the great-great-granddaughter of Henry VII, whose daughter Margaret, having been first married to James IV of Scotland, became by a second marriage the mother of Margaret Douglas, mother of Darnley, and Charles Stuart, Earl of Lennox. She received an excellent education. Her proximity to the throne was the source of her misfortunes. Elizabeth, for some time before her decease, held the Lady Arabella under restraint, and refused the request of the king of Scotland to give her in marriage to the Duke of Lennox, his kinsman, with a view to remove her from England. The Pope had likewise formed the design of raising her to the English throne, by espousing her to the Duke of Savoy; which project is said to have been listened to by Henry IV of France, from a wish to prevent the union of England and Scotland. The detection of a plot of some English nobles to set aside James in favor of Arabella Stuart, of which she was altogether innocent, ultimately proved her destruction; for although left at liberty for the present, when it was some time after (in 1610) discovered that she was secretly married to William Seymour, son of Lord Beauchamp and grandson of the Earl of Hertford, both husband and wife were placed in confinement, the husband being committed to the Tower. At the end of a year they both contrived to escape at the same time, but the unhappy lady was retaken. She was then herself committed to the Tower, the remainder of her life was spent in close confinement, which finally deprived her of her reason. Consult Bradley, E. T., 'Life and Letters of Lady Arabella Stuart' (London 1889).

STUART, Charles Edward Louis Philip Casimir, of Scotland: b. Rome, 31 Dec. 1720; d. there, 31 Jan. 1788. He was a son of James Francis Edward Stuart, and was known variously as the «Young Pretender,» the «Young Chevalier,» and «Bonny Prince Charlie.» He first saw service at the siege of Gaeta (1834); fought bravely at Dettingen (1743); and next year repaired to France to head Marshal Saxe's projected invasion of England. Sailing from Nantes, he landed with seven followers at Eriska in the Hebrides on 2 Aug. 1745, and on the 19th raised his father's standard at Glenfinnan. The clansmen flocked in; on 17 September Edinburgh surrendered, though the castle still held out; and Charles held court at Holyrood, the palace of his ancestors. There followed the victory over Sir John Cope at Prestonpans, the march upon London with 6,500 men, the fatal turning at Derby (6 December), the victory over Hawley at Falkirk (17 Jan. 1746), the crushing defeat by the Duke of Cumberland at Culloden (16 April), and Charles' five months' hidings and wanderings. The peace of Aix-la-Chapelle (1748) caused his forcible expulsion from France, and thereafter he lived successively at Avignon, Liège, Basel, Florence and Rome.

STUART, Charles Macaulay, American theologian: b. Glasgow, Scotland, 20 Aug. 1853. He was graduated (1880) at Kalamazoo College and took the A.M. degree (1883) at Garrett Biblical Institute and Northwestern University (1887). He was pastor at River Forest, Ill. (1880–83), at Fort Saint Church, Detroit (1883–85), becoming associate editor *Michigan Christian Advocate* (1885–86) and filling the same position on the *Northwestern Christian Advocate* (1886–96). From 1896–1909 he was professor of sacred rhetoric at Garrett Biblical Institute and was appointed editor *Northwestern Christian Advocate,* 1909–11. He became president of Garrett Biblical Institute in 1911. He has written 'Gospel Singers and Their Songs' (1891); 'Vision of Christ in the Poets' (1896); 'Story of the Masterpieces' (1897). He also edited the 'Methodist Hymnal' (1905); 'In Memoriam, Charles J. Little' (1912); 'The Manifold Message of the Gospel' (1913).

STUART, Elizabeth, daughter of James I of England. See ELIZABETH STUART.

STUART, Gilbert, American painter: b. Narragansett, R. I., 3 Dec. 1755; d. Boston, 27 July 1828. He was a portrait painter and began at the age of 13. In 1775 he paid his second visit to England where Benjamin West recognized his talent, took him into his home and gave him instruction in art. Eventually obtaining much favor and distinction in London he painted portraits of George III, George IV while prince of Wales, Mrs. Siddons, Sir Joshua Reynolds, Benjamin West, and at Paris had Louis XVI as sitter. His great ambition, however, was to practise his art in his own country and he returned to the United States 1792 and opened a studio first in New York; subsequently in Philadelphia, where he painted Washington in 1795. This was the first of a series of portraits of the «Father of his Country» by Stuart. There are still extant six half-face portraits from the same sitting, painted from the right. The famous «Athenæum portrait,» now in the Boston Museum, was produced about 1796 and takes the left half face of the sitter. Somewhere about the same time he painted a full-length portrait of Washington for the Marquis of Lansdowne. Nearly 40 copies made by him from the original of various sittings are now in existence. In the Metropolitan Museum of Art, New York, Stuart is represented by six pictures, namely 'Washington' (two portraits); 'John Jay'; 'Captain Henry Rice'; 'Mr. David Sears'; 'Commodore Isaac Hull.' He also painted the first five Presidents of the United States; Edward Everett, Jacob Astor; Judge Story; W. E. Channing; Josiah and Edmund Quincy and O. H. Perry. The characteristics of Stuart's portraits are fine coloring and life-like expression. Though he has been charged with incorrectness of drawing, he ranks with some of the best portrait painters of the English-American school. Consult Mason, 'Life and Works of Gilbert Stuart' (1879); Isham, S., 'History of American Painting' (New York 1915).

STUART, Henry Benedict Maria Clement, Duke of York, cardinal and bishop of Frascati; b. Rome, 5 March 1725; d. Paris, 1799. He was a son of James Francis Edward Stuart. In 1747 received a cardinal's hat from Benedict XIV. Clement XIII consecrated him bishop of Corinth, and subsequently appointed him to the suburban see of Frascati. He enjoyed, through the favor of the French court, the revenues of two rich abbeys, as well as a Spanish pension; and the liberal charity with which he dispensed his income endeared him to his flock. On his brother's death in 1788 he caused a medal to be struck, bearing the Latin legend, «Henry IX, king of England, by the grace of God, but not by the will of men.» The French Revolution stripped him of his fortune.

STUART, James, Earl of Murray; regent of Scotland: b. 1533; d. 21 Jan. 1570. He was the natural son of James V by Margaret, daughter of Lord Erskine. At five years of age his father made him prior of Saint Andrews, and he was long known by that title. He became a warm supporter of the Reformers, and was chosen a member of the council, and one of the lords of the articles. On the return of Mary to Scotland as queen, Murray became her chief adviser, and was created first, Earl of Mar, and then Earl of Murray. He was opposed to the queen's marriage with Darnley, and has been accused of implication in the murder of the latter. He remained out of Scotland for some months in 1567, only returning on the accession of James VI. He saw his sister a captive in Lochleven Castle, and was soon after named regent. Mary having escaped and taken arms, he encountered and defeated her at Langside, in 1568. He was assassinated at Linlithgow.

STUART, James, English antiquary and architect: b. London, 1713; d. 2 Feb. 1788. In his early days he devoted himself to the painting of fans, a profession which gave some room for the cultivation of a genuine artistic talent. In 1742 he went to Rome and engaged in the study of its architectural monuments. When in 1750 he accompanied Nicholas Revett to Greece, he found leisure and opportunity for completing his architectural knowledge. After traveling from point to point of antiquarian interest he finally settled in Athens for nearly three years and amassed a great body of material in the way of sketches and antiquarian notes. He returned to England in 1755 where he found his services much sought after as an architect, but his principal employment was the completion of his *magnum opus,* 'The Antiquities of Athens' in three volumes, only one of which was published before his death.

STUART, Sir James, Canadian jurist and statesman: b. Fort Hunter (now in New York State), 4 March 1780; d. Quebec, 14 July 1853. He was educated at Schenectady, then at King's College, Windsor, Nova Scotia. He next studied law in a prothonotary's office at Montreal, then (1798) becoming a pupil of Jonathan Sewell at Quebec. In 1800 he was appointed assistant secretary to the government of Lower Canada and was called to the bar in 1801 and made solicitor-general for the province. He entered the House of Assembly (1808) as member for Montreal. In consequence of disagreements he had to resign the solicitor-generalship and joined the opposition. He was sent to England by the advocates of the union of Upper and Lower Canada and (1825), was appointed attorney-general for Lower Canada and was elected the same year to the Assembly. Beaten in the following election (1828), he was next (1831) impeached by the House of Assembly and was suspended from office by Lord Aylmer, the claims against him being corruption in elections and improper use of office. The litigation was kept open by him in his defense both in Canada and England, but (1834) he resumed his private practice and his great success was proof of the public's confidence in him. In 1838 he was appointed chief justice of Lower Canada. He at once re-entered the political field, assisted Lord Sydenham with his advice and drew up many legal ordinances and other work in framing the union. He was created baron in 1841 for his services and on the union of the two Canadas became chief justice of Lower Canada.

STUART, James Ewell Brown, American soldier: b. Patrick County, Va., 6 Feb. 1833; d. Richmond, Va., 12 May 1864. He was descended on his father's side from ancestors distinguished during the colonial and Revolutionary periods, in the War of 1812, and in civil life in Illinois, Missouri and Virginia. On his mother's side he was a descendant of the Letcher family of Virginia. After a course at Emory and Henry College, in Virginia, he entered the National Military Academy at West Point, N. Y., and upon his graduation in 1854 was commissioned third lieutenant and in October of the same year was promoted to the rank of second lieutenant. After serving with the mounted riflemen against the Apaches in Texas he was transferred to the First Cavalry, then stationed at Fort Leavenworth. In December 1855 he was promoted first lieutenant, about a month after his marriage at Fort Riley to the daughter of Col. Philip St. George Cooke. He accompanied Col. Robert E. Lee as aide in the attack upon John Brown and his raiders at Harper's Ferry, where he read to Brown the summons to surrender. In April 1861 he received from the United States government the commission of captain; but he had decided to go with Virginia, and as soon as his resignation was accepted (7 May 1861) tendered his services to his native State, and was three days later commissioned lieutenant-colonel of Virginia infantry. Reporting to «Stonewall» Jackson at Harper's Ferry, he was promoted colonel 16 July 1861, and at the head of 350 cavalrymen began his brilliant career. On outpost duty he was ever vigilant and wary, and of his service at the first battle of Manassas (Bull Run), where he made a dashing charge, General Early wrote that «Stuart did as much toward saving the battle as any subordinate who participated in it.» After the victory had been won he pursued the Federals 12 miles. Subsequently he held the heights in sight of Washington with headquarters on Munson's Hill. In front of this position and at Dranesville he had combats with the Federals. On 24 Sept. 1861 he was commissioned brigadier-general. In the spring of 1862 he covered the retreat from Yorktown and opened the battle at Williamsburg (q.v.). For his daring raid around the army of General McCellan, just before the Seven Days' Battle, (q.v.), Stuart won the applause and hearty admiration of both friend and foe, and on 25 July 1862 he was commissioned major-general. He won additional fame by his raid around Pope's army, in which he captured that general's headquarters and a part of his staff at Catlett's Station by his raid in conjunction with General Trimble upon the Federal depot of supplies at Manassas, his services in screening the movement of Lee's army into Maryland, the brilliant fighting of his troopers at the passes of South Mountain, and by the skill with which he managed his horse-artillery on the Confederate left at Sharpsburg (Antietam), where with these hard fighters he powerfully assisted in the repulse of Sumner's gallant charge.

In October after the battle of Sharpsburg Stuart led his bold horsemen to Chambersburg, Pa., and on his return, thwarting every effort of the Federal cavalry to intercept him, passed between McClellan's army and Washington, and with little loss recrossed the Potomac into Virginia. This expedition caused great demoralization in the Federal cavalry, and by delaying McClellan's advance gave to the Army of Northern Virginia several weeks for rest and preparation against a new invasion.

After the mortal wounding of "Stonewall" Jackson and the disabling of A. P. Hill on 2 May at Chancellorsville, Stuart took command of Jackson's corps and by his audacious attack upon greatly superior numbers completed the work so brilliantly begun by Jackson. When Lee began his movement into Pennsylvania, Stuart, after defeating the Federal cavalry at Fleetwood, or Brandy Station (q.v.), passed again between the Federal army and Washington with orders to meet Early at York. Marching almost without rest for eight days and nights, the last three with almost constant fighting, he joined Lee's army at Gettysburg (q.v.), bringing with him a large train of captured Federal supplies. On the third day of the battle he made a fierce attack upon the cavalry on the Federal right, and at Williamsport, on the retreat, came up in time to drive off the heavy odds of Federals, who were making a desperate fight to capture the Confederate train so bravely defended by General Imboden. On 5 May 1864 he guided the movement of A. P. Hill's corps against Grant's advance, on the 7th gave notice to Lee of Grant's flank march to Spottsylvania Court House and, throwing his cavalry in front of the Federals, delayed them until the Confederate infantry could be thrown across their path. When Sheridan attempted to make a sudden dash into Richmond, Stuart with a part of the cavalry barred his way at Yellow Tavern (q.v.), and saved the Confederate capital. But he received a mortal wound, of which he died next day (12 May 1864) in Richmond. John Esten Cooke has written thus of his last moments: "As his life had been one of earnest devotion to the cause in which he believed, so his last hours were tranquil, his confidence in the mercy of heaven unfailing. When he was asked how he felt, he said, 'Easy but willing to die, if God and my country think I have done my duty.' His last words were: 'I am going fast now; I am resigned. God's will be done.' As he uttered these words he expired."

In every battle Stuart's black plume had waved in the advance. In every arm of the service he had won the highest honors. Gay and rollicking in camp, merry on the march, often calling upon Sweeny to ride by his side and thrum upon the banjo an accompaniment to his merry songs, he was always fully awake to the demands of duty and equal to any emergency. See STUART'S RAID TO CHAMBERSBURG; STUART'S RIDE AROUND THE ARMY OF THE POTOMAC ON THE CHICKAHOMINY. Consult McClellan, H. B., 'The Campaigns of Stuart's Cavalry' (1885).

JOSEPH T. DERRY,
Author of 'History of Georgia.'

STUART, James Francis Edward, the Pretender, of Scotland: b. Saint James Palace, 10 June 1688; d. Rome, 1 Jan. 1766. He was a son of James, regent, and Mary of Modena. At six months he was conveyed by his fugitive mother to Saint Germains, where his boyhood was passed, and where, on his father's death in 1701, he was proclaimed his successor. In an attempt, in March 1707, to make a descent upon Scotland, the young "Chevalier de Saint George," as he was styled by his adherents, showed some gallantry, but was not suffered to land; and after his return he served with the French in the Low Countries, at Malplaquet receiving a sword-thurst in the arm. But in Mar's ill-conducted rebellion (see JACOBITES) he showed himself heavy, spiritless, even tearful, when, too late in the day, he landed at Peterhead (22 Dec. 1715), and sneaked away six weeks afterward from Montrose. France was now closed to him by the treaty of Utrecht, and almost all the rest of his fainéant, dissolute, prayerful life was passed at Rome. In 1719 he married Maria Clementina Sobieski, granddaughter of John Sobieski, king of Poland. Charles Edward, his son, was the Young Pretender.

STUART, John McDouall, Australian explorer: b. Dysart, Fifeshire, Scotland, 7 Sept. 1818; d. London, 5 June 1866. He was educated in Edinburgh, where he engaged in business for some time. In 1838 he went to Australia and accompanied Sturt's expedition into the interior, 1844–46. In 1858 he started a series of six expeditions in search of a path across the continent of Australia. The first had no noteworthy result; but on the second, in 1859, he explored much of the country about Lake Torrens. In 1860 he penetrated to the centre of Australia and discovered Mount Stuart; and at last, in 1862, his sixth expedition, succeeded in crossing Australia near the centre of the continent, from south to north and back again. For this achievement Stuart was granted £2,000 and 1,000 square miles of land by the Australian government. He wrote 'Explorations in Australia,' edited and published by W. Hardman (1864).

STUART, Moses, American biblical scholar and theological teacher: b. Wilton, Conn., 26 March 1780; d. Andover, Mass., 4 Jan. 1852. He was graduated at Yale in 1799; studied law, and was admitted to the bar in 1802; was tutor at Yale for two years; studied theology with President Dwight; in 1806 became minister of the First Church (Congregational) in New Haven; and in 1809 entered upon his life-work as professor of sacred literature in the Andover (Mass.) Theological Seminary, a position which he held until 1848. In the encouragement and direction of biblical study during this period his influence was widely felt, as it also was in the theological discussions of the time, which enlisted many able controversialists of various schools. More than 1,500 ministers were the recipients of his teachings at the seminary, and many pens and pulpits aided in the propagation of his views. Besides textbooks and commentaries relating to the biblical writings, he published 'Elements of Interpretation,' from the Latin of Ernesti (1822); 'Philological View of Modern Doctrines of Geology' (1836); 'Hints on the Prophecies' (1842); 'Critical History and Defense of the Old Testament Canon' (1845), and a volume of 'Exegetical Essays' (1867).

STUART, Ruth McEnery, American author: b. Avoyelles, La., 1856; d. 4 May 1917. She was educated in New Orleans until 1865; removed to New York in 1885. Her writings include 'A Golden Wedding, and Other Tales'

(1893); 'Carlotta's Intended, and Other Stories' (1894); 'The Story of Babette' (1894); 'Solomon Crow's Christmas Pockets' (1896); 'Sonny' (1896); 'The Women's Exchange' (1899); 'Napoleon Jackson' (1902); 'George Washington Jones' (1903); 'The River's Children' (1904); 'The Second Wooing of Salina Sue' (1905); 'Aunt Amity's Silver Wedding' (1908); 'Sonny's Father' (1910); 'The Haunted Photograph' (1911); 'Daddy Do-Funny's Wisdom Jingles' (1913); 'The Cocoon' (1915).

STUART'S RAID TO CHAMBERSBURG, Pa. Early in October 1862 the Army of the Potomac, under General McClellan, was encamped on the Maryland side of the Potomac, its infantry from Hagerstown, on the north, to beyond the Monocacy, on the south, with cavalry on both flanks. Advised of some movements in the Union army, General Lee, to ascertain the nature of these movements and to disarrange McClellan's plans for crossing the Potomac, ordered Gen. J. E. B. Stuart, on 8 October, to cross the Potomac, above Williamsport, with cavalry, destroy bridges and railroads, seize horses, do all the damage possible and, if advisable or necessary, recross the Potomac in the vicinity of Leesburg. Stuart selected 1,800 men, 600 each from his three brigades, commanded by Gen. Wade Hampton, and Cols. W. H. F. Lee and W. E. Jones. At daylight of the 10th he crossed the Potomac at McCoy's Ford above Williamsport, with slight opposition, captured the signal station at Fairview, passed Cox's Kanawha division near Clear Spring, taking 10 stragglers from it, and marched northward and along the western side of the Cumberland Valley, by way of Mercersburg to Chambersburg, where he arrived at 8 P.M. and passed the night. In the morning of the 11th he destroyed the railroad depots and such military supplies as could be found, including 5,000 new muskets, pistols and a large amount of army clothing; captured and paroled 280 sick and wounded soldiers in hospital; and seizing over 500 good cavalry horses in the surrounding country, and leaving the town quite early, crossed the South Mountain to Cashtown, where he turned southward, passed to the west of Gettysburg and through Fairfield to Emmittsburg, and thence toward the Potomac. All through Pennsylvania he had gathered in horses, but none were taken from Maryland farms or towns. He passed Emmittsburg after dark, and during the night pushed on, most of the time at a trot, through Woodsborough, Liberty, New Market and Monrovia, where he cut the Baltimore and Ohio Railroad, and reached Hyattstown early on the 12th, and continued his march to Barnesville, having met no opposition. As soon as it became known that Stuart had crossed the Potomac there was great excitement. Governor Curtin ordered out troops at Harrisburg; General Wool sent troops from Baltimore to Harrisburg and Chambersburg; Cox's Kanawha division, which was on the way from the Army of the Potomac to Clarksburg, W. Va., was halted at Clear Spring, near Hagerstown; all the fords of the Potomac above and below Harper's Ferry were carefully guarded by infantry; and two brigades of infantry were placed on cars, with steam up, at the railroad crossing of the Monocacy, near Frederick, ready to move at once to the point where Stuart might cross the railroad. Infantry was placed at such points back from the river as it was supposed he would pass on his return. Averell's cavalry was ordered down from near Hancock, and Pleasonton's cavalry, then near Hagerstown, was started in pursuit. McClellan was sure that Stuart's escape was impossible. Stuart heard of the preparations to intercept him, through a captured courier carrying a dispatch, and having skilfully avoided Pleasonton's cavalry, pushed on through Barnesville, passed through Stoneman's division of Union troops lying between Poolesville and the mouth of the Monocacy, and sent the head of his column, under Colonel Lee, to secure a crossing of the Potomac, at White's Ford, while with the rear-guard he held in check Pleasonton, who was advancing from the Monocacy. Colonel Lee found White's Ford guarded by a part of the 99th Pennsylvania infantry, strongly posted on a bluff commanding the ford, and he summoned it to surrender, but met with no response, and at the end of 15 minutes opened with artillery and advanced his skirmishers; upon which the Union infantry retreated and Lee seized the crossing. Stuart, who had been engaging Pleasonton with artillery, followed Lee and in a short time had crossed the river, with over 1,200 horses from the farms of Pennsylvania, and some prisoners, 30 of whom were "public functionaries and prominent citizens," to be held as hostages for citizens of the Confederacy who had been arrested and imprisoned. In the entire expedition Stuart had but one man wounded; two men were captured. From the time of leaving Chambersburg until he reached the Virginia shore at noon of the 12th Stuart had marched more than 80 miles; and during the same period Pleasonton had marched about the same distance. The result of the expedition was very gratifying to Lee, for Stuart brought him valuable information; but it was mortifying to the Union officers to know that Stuart had succeeded in riding for a second time clear around the Army of the Potomac, and it delayed the movement of McClellan, who says that the exhausting service in chasing Stuart "completely broke down nearly all the cavalry horses, and rendered a remount absolutely indispensable before we could advance on the enemy." Consult 'Official Records' (Vol. XIX); Allan, W., 'Army of Northern Virginia in 1862' (New York 1867); McClellan, 'Life of Gen. J. E. B. Stuart.'

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STUART'S RIDE AROUND THE ARMY OF THE POTOMAC ON THE CHICKAHOMINY. While General Lee was making arrangements in June 1862 to bring "Stonewall" Jackson from the Shenandoah Valley, to unite with the army at Richmond in a blow upon McClellan, he ordered Gen. J. E. B. Stuart, commanding his cavalry, to make an expedition around the right and to the rear of McClellan's army to ascertain its position and movements. Stuart made a verbal suggestion that it was possible to ride clear around McClellan, and he was permitted to use his discretion in the matter. With portions of the First, Fourth and Ninth Virginia cavalry, under Cols. Fitzhugh Lee and W. H. F. Lee, two squadrons of the Jeff Davis Legion, under Lieut.-Col. W. T. Martin, and a section of artillery under Lieutenant Breathed, in all about 1,200 men, Stuart started from near Kelly's Station, on the north bank of the Chickahominy, on the morning of 12 June 1862, and marched northward, west of the Richmond and Fredericksburg Railroad and parallel to it, bivouacking at night near the railroad bridge over the South Anna, 22 miles from Richmond. No fires were permitted at night, nor bugle-call in the morning, when he turned toward Hanover Court House. At the Court House was a detachment of Union cavalry, which Stuart endeavored to surround and capture, but it escaped in the direction of Mechanicsville, and Stuart kept on in the direction of Hawes' Shop and Old Church. Soon after he left the Court House a squadron of the Fifth United States cavalry, under Lieutenant Lieb, was encountered, which fell slowly back toward Old Church, from which it had advanced that morning on a reconnaissance. Stuart followed cautiously, took some prisoners, crossed Totopotomoy Creek, and was nearing Old Church when he met Capt. W. B. Royall, who, informed of his approach, had marched from Old Church and joined his squadron to Lieb's, making not to exceed 125 men. Stuart ordered a charge, which was led by Captain Latané, of the ninth Virginia cavalry. The contest was short and severe, sabres being freely used; Latané was killed and a few men wounded; Royall was wounded by several sabre-cuts; and the Union cavalry was driven back and with difficulty partially rallied by Lieb. Stuart pressed on, drove Lieb, captured and destroyed Royall's camp, and took some prisoners. He had fulfilled his orders by passing entirely around McClellan's right, and had gained sufficient information for General Lee's purposes; but instead of returning, he determined to cut McClellan's communications, go entirely around his army, make him, «tremble in his boots,» cross the Chickahominy beyond his left at Forge Bridge, and reach Richmond. Two squadrons were sent to the left to Garlick's Landing, on the Pamunkey, and destroyed two loaded transports and some wagons, killing two men and taking some prisoners; while Stuart with the main body marched to Tunstall's Station of the York River Railroad, surprised and captured the guard of 15 or 20 men, overhauled a number of wagons, and fired into a passing railroad train, killing three men and wounding eight. The railroad bridge over Black Creek, near by, was burned, also several wagons and some public stores, when Stuart marched by moonlight to Talleysville, where he halted nearly four hours, and at midnight resumed his march for Forge Bridge, which was reached at daylight of the 15th. The bridge was gone, and the river too high for fording. Some crossed by swimming; but the debris of an old bridge was found; there was a warehouse near by, which was torn down, and Lieutenant Burke, with a party, was set to work to build a bridge. Stuart says: «A foot-bridge was soon improvised, and the horses were crossed over as rapidly as possible by swimming. Burke's work progressed like magic, in three hours it was ready to bear artillery and cavalry, and as half the latter had not yet crossed, the bridge enabled the whole to reach the other bank by 6 P.M. Another branch of the Chickahominy still further on was with difficulty forded, and the march was continued without interruption to Richmond.» Besides the property destroyed, Stuart reports that he took into Richmond with him 165 prisoners, 260 mules, harness, etc. The only one killed in his command was Captain Latané, and but few were wounded. The whole affair was very mortifying to McClellan. The orders given for pursuit of Stuart came from four or five general officers, and were so conflicting that movement was paralyzed. The expedition confirmed General Lee in his plan of bringing Jackson down on McClellan's right. See PENINSULAR CAMPAIGN OF 1862; SEVEN DAYS' BATTLES.

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STUBBES, Philip, English author: b. about 1555; d. London, about 1610. He was educated at Cambridge, and in 1581 began to write a series of ballads and other pamphlets directed against the sinful practices of various persons whose conduct did not reach his puritanical standard, and later published a broadside against the English public, entitled 'A View of Vanitie and Alarum to England, or Retrait from Sinne.' This was followed by his more ambitious and better-known arraignment of the world in general, which he called 'The Anatomie of Abuses, conteyning a Discoverie or Briefe Summarie of such Notable Vices and Imperfections as now raigne in many Christian Countreyes of the World,' which was published in 1583. His later diatribe 'A Chrystal Glasse for Christian Women' (1591) was still more widely known. Consult Morley, H., 'English Writers' (London 1892).

STUBBS, William, English prelate and historian: b. Knaresborough, Yorkshire, 21 June 1825; d. Oxford, 22 April 1901. He was educated at Oxford University, took Anglican orders in 1848 and was vicar of Navestock, Essex, 1850–60. He was librarian of Lambeth Palace, 1862–68 and regius professor of modern history at Oxford, 1866–84. In 1869 he became curator of the Bodleian Library, and was rector of Cholderton, Wiltshire, 1875–84. He became in 1879 canon residentiary of Saint Paul's, in 1884 bishop of Chester and in 1888 bishop of Oxford. He edited many valuable historical works in the Rolls Series, including 'Chronicles and Memorials of the Reign of Richard I' (1864–65); 'Gesta Regis Henrici II' (1867); 'Chronicle of Roger Hoveden' (1872–73); 'Memorials of Saint Dunstan' (1874); and 'Opera Radulphi de Diceto' (1876), but is best known by his 'Constitutional History of England' (1874–78). Among other works of his are 'The Early Plantagenets' (1876); 'Seventeen Lectures on the Study of Mediæval and Modern History' (1886); 'Registrum Sacrum Anglicanum,' a calendar of the English bishops from the time of Augustine (1858); 'Councils and Ecclesiastical Documents Relating to Great Britain and Ireland' (1869–73), and the posthumous works, 'Lectures on European History' (1904); 'Letters' (1905); 'Lectures on Early English History' (1906); 'Ordination Addresses' (1901); 'Visitation Charges' (1904); 'Germany in the Middle Ages' (1908). Consult Gross, 'Sources and Literature of English History' (New York 1900) and Hutton, W. H., 'Letters of William Stubbs' (London 1906).

STUCCO, *in architecture,* a composition of white marble pulverized and mixed with plaster of lime, which, being sifted and wrought up with water, is used like common plaster. Architectural and sculptural ornaments, such as fruits, flowers, garlands, festoons, etc., are made of it. In the interior of buildings stucco work is generally applied to the ceilings of apartments, the moldings, etc. In some countries a stucco of common mortar and of plaster is applied to the outside of houses, and is extremely durable.

STUCK, Franz, KNIGHT VON, German painter: b. Tettenweis, Lower Bavaria, 23 Feb. 1863. He received his early art training in the academy at Munich under Lindenschmit and exhibited striking and original talent by his fantastic and grotesque designs, many of them furnished as illustrations to the *Fliegende Blätter,* as book covers, vignettes for programs, etc. In 1889 he made his début as a painter in oils with ‘The Seraph at the Gate of Paradise’; and numerous other Biblical, mythological and allegorical works followed. His chief works are ‘Lucifer’; ‘The Expulsion from Paradise’; a ‘Pietà’; ‘The Crucifixion’; ‘Sin’ (1893); ‘War’ (1894), both in the Munich Pinakothek; ‘The Sphinx’ (1895), now in Budapest); ‘Evil Conscience’ (1896); ‘Procession of Bacchantes’ (1897); ‘Pan’ (1908); ‘Innocentia’ (1909). Among his most successful portraits is one of Fritzi Scheff. He has also produced several statuettes and bronze figures, including ‘The Faun’ (in the Berlin National Gallery), and is professor royal in the Munich Academy. He is regarded now as one of the greatest figures in modern German art, although at first his work was scorned and derided. Consult Bierbaum, O. J., ‘Stuck’ (in ‘Künstler-Monographien,’ Vol. XLII, Bielefeld 1899); Singer, H. W., ‘Franz Stuck: Zeichnungen’ (Leipzig 1912); Hanfstängl's reproductions (Munich 1909).

STUCK, Hudson, American clergyman; b. England, 11 Nov. 1863. He was graduated (1892) at the Theological Department, University of the South, Sewanee, Tenn. He became (1892) deacon and priest of the Protestant Episcopal Church and rector (1892–94) at Grace Church, Cuero, Tex., dean (1894–1904), Saint Matthew's Cathedral, Dallas. Since 1904 he has been archdeacon of the Yukon. He has written ‘Ascent of Denali’ (Mount McKinley) (1914); ‘Ten Thousand Miles with a Dog Sled’ (1914); ‘Voyages on the Yukon and its Tributaries’ (1917). He was in the first party of three climbers to reach the summit of Denali Peak, in 1913, about 20,500 feet high; an account of the ascent is the subject of one of the above-mentioned works.

STUCLEY, stŭk'lĭ, or **STUKELY, Thomas,** English adventurer: b. about 1525; d. Alcazar, 4 Aug. 1578. He was sent to England (1552) recommended by Henry II of France, to whose notice he had been brought through his military talents. Instead of obtaining the secret information he was sent for that would assist the French to land on English shores after a projected capture of Calais, he disclosed the French royal plot. Instead of being rewarded for his information he was thrown into the “Tower” and the Duke of Northumberland betrayed him in turn to the French king. Escaping from prison he entered service under Emperor Charles V and the Duke of Savoy. He was actively present at the victory of Saint Quentin (1557), after which he went on a privateering expedition, Queen Elizabeth providing one of his fleet of six ships (1563). His voyage was a series of robbery from ships of every nationality. After two years of piracy the remonstrances of other nations caused Elizabeth to arrest him. Upon being pardoned he went to Ireland where he is alleged to have started further plotting but the queen squelched his ambitious schemes. He had been in correspondence with Philip II of Spain, accepting a pension from him. Suspicion of his treason came up in court and he fled to Spain (1570) where he again plotted against England. He visited Paris and the papal court, then joined in an expedition against Morocco backed by Portugal but was killed in the battle of Alcazar (1578). The story of Stukely's career was very popular in England as he was said to have been an illegitimate son of Henry VIII, king of England. A play entitled ‘The Battle of Alcazar . . . with the Death of Captain Stukely’ was printed by E. Allde in 1594. Later ‘The famous History of the Life and Death of Captain Stukely was printed (1605). Simpson's ‘School of Shakespeare’ (1878, Vol. I) gives a detailed account of Stukely's career based on state papers.

STUDENT LIFE AND CUSTOMS. Student life and customs have varied so much in various ages and countries, and have differed so greatly according to the school, elementary, secondary or college, in which the students are, that it is necessary to divide and subdivide the subject for effective treatment.

Consideration must be given to ancient, mediæval and modern times; particular countries in those ages; the grade of institution, whether elementary, secondary or collegiate, in each country; and the life of the student both inside and outside of the classroom or academic precincts.

We lack sufficient evidence to make many statements about student life in ancient times. That which we do know has almost entirely to do with the teaching in the classroom (see EDUCATION, HISTORY OF). Of the life of the student there, the connection between flogging and learning was the feature — “he that is not flogged, can not be taught.”

With the Greeks much of the instruction given to the young was in the nature of that which we should call supervised sports. This being the case student life for the young was happy and entertaining. The Greek boy played ball, flew kites and rolled marbles, and engaged in similar recreations.

As he grew older, if he were not apprenticed to a trade, he attended the gymnasia, which were open air exercising grounds. Here he got instruction in running, wrestling, boxing, spear throwing, jumping and hurling the discus. Horse-back riding and chariot driving were also a part of his instruction. Oratory and music came nearer than other subjects to being academic work in our sense of the word, but to-day even these subjects are likely to be more thought of in the nature of student life rather than a part of the instructional work in our educational institutions.

The Roman schools partook a little more of the nature of actual classrooms, though in most cases they were merely a sort of pergola. School-boy life was enlivened with floggings, as with the Greeks, but seemingly more systematic classroom work was done by the Romans. The latter did not give the time to formal instruction in sports that the Greeks gave, so that to the Roman boy and youth his amusements were much more his own. Marbles, blindman's buff, hide and seek and other games of childhood were played. Riding, swimming and wrestling were, however, a regular part of the instruction, and the Roman youth entered them with a seriousness that made them less a part of the lighter side of life. With the Romans, therefore, the sports of student life tended to fall into the class of the professionals.

For some centuries after the gradual decline of the Roman civilization until the beginning of those schools which grew up in connection with the Christian churches there is little evidence of any kind of school life. When the church and monastic schools did begin to come into existence, they were looked upon as places where in general boys were to be prepared for the service of the Church. Even those who were not to be so prepared were given the same kind of training. In view of the severity of the ideal of preparation for the Church the school life of the boy both during the hours of actual instruction and outside of such hours was one of constant task and supervision. Almost every sport to which a boy of the time might turn was prohibited under the severest penalties. Flogging, even of young men of 18, was common. Unlike the schools of the Greeks and the Romans, those in the Middle Ages were frequently of the kind to which boys went to live during their period of school life. The only holidays he had were those of the Church.

In spite of the extreme repression of all youthful inclinations, the boys committed numerous offenses in the schoolrooms and in chapel. Some, when they got a chance to get away from the strict supervision of the teacher, indulged in all kinds of prohibited sports, such as cock-fighting, gambling and fist fighting.

It was in the mediæval universities that we first hear of those student groups which gave color to a real student life such as we know it. The freshman was then, as until recently in our own colleges and universities, the particular object of attack on the part of those who had been in the institution longer than he. He was likely to be waylaid and thoroughly pummeled before arrival. In Germany and France he was put through an initiation bordering on the grotesque, horrible and cruel — far worse than the modern initiation to any of our secret societies. If he passed through such ordeals and succeeded in getting registered with a master or in a college, his life in the classroom and out of it was marked by turbulence and hardship. A master who delivered his lecture too rapidly was interrupted with all kinds of noises. The lecture-rooms were wholly unheated in winter and the windows unglazed. The floors were covered with straw on which the student sat. The rooms in which the students lodged were equally uncomfortable and the sanitary arrangements negligible. The ecclesiastical gowns which they were required to wear afforded them scant protection against the cold, unless they were fortunate enough to be able to buy furs. Many of the students were well-to-do and others extremely poor. In whichever condition they found themselves letters to their parents which have come down to us give evidence of that almost chronic appeal of all students in all ages for more money. The poorer students frequently begged and were sometimes officially licensed to do so.

So many of their natural inclinations for the amusements and sports of youth were repressed by strict prohibitions that the natural consequences followed. Not having any outlet for their youthful spirits they indulged in riotous conduct. Brawls amongst the individual students and those of different national groups were frequent, and occasionally a whole group of them would get into conflict with the townsfolk, so that "Town and Gown" fights became infamous. As the students as well as the townsfolk went about armed, these battles frequently ended in bloodshed and death.

In spite of such incidents which were of course not of the usual, but of the unusual class, the mediæval student did a goodly amount of serious work, some naturally more and some less. The absence of healthy sports to relieve the daily routine was his most serious trouble.

The hold, which student customs have, brought many of them far down into modern times, not only in Europe but also in America. Curious survivals in the treatment of freshmen, fagging, the conflict between the freshmen and the sophomores, represented at Harvard until a short time ago by "Bloody Monday Night," and at other colleges by cane rushes, and the like, bear witness to this conservatism.

The popularizing of college education and the removal by university authorities of many of the restrictions on the natural impulses of youth for activity have led to the gradual disappearance of the many so-called mediæval customs. In their place has grown up a bewildering variety of activities for the student, which form a large part of his life. A perusal of the daily or weekly paper, or monthly, or annual periodicals published by the students in almost everyone of our institutions of collegiate rank, particularly in the United States, reveals not only the literary activity along such lines, but in the notices, which they publish, they bear witness to the existence of an extended variety of sports — baseball, football, rowing, tennis, lacrosse, basketball, hockey; numerous clubs and fraternities to which almost every student of any walk in life may belong; debating organizations, dramatic societies presenting operas and plays, musical clubs and orchestras, foreign language clubs and religious societies. Many of these intramural activities are represented also by intercollegiate contests in almost all of the sports, in debating, oratory and music.

On the social side dancing and singing, in large choruses, both during term time and at graduation exercises occupy a prominent place, especially at girls' colleges, which, after their establishment, in many ways followed in the footsteps of those for men. Luxurious living quarters have taken the place of the bare and comfortless rooms of less than half a century ago.

Though in America student life has gone

far beyond anything in the way of student life and customs, such as they exist in Germany, France and Italy, the English universities are a very close second. In the latter as well as in America there is that love of the «Alma Mater» which is not at all to be found on the continent of Europe. In the larger cities of America are to be found clubs of the graduates of the various institutions which hold them by close ties to the institutions from which they were graduated. There the student life and customs take a longer lease of life, especially at the time of the great intercollegiate athletic contests.

On the continent of Europe there is no such broad development of student life and customs as is found in Great Britain and America. The usual absence of dormitories or living halls in the great universities of Germany, France, Italy and Spain, the treatment of the universities as great day schools, the common practice of the students to take some semesters of academic work in one institution and some in another, the slight development of athletics, and other minor factors have caused the failure to develop that variety of student life and customs and that abiding affection for the «Alma Mater» found in English-speaking countries.

Student life and customs in schools of elementary and secondary grade were under the same repression as the colleges during the Middle Ages and came out from under it far less slowly than the latter. The tendency to imitate the higher institutions was very strong in all countries, and during the 19th century the secondary institutions reflected the student life and customs of the colleges and the elementary schools reflected those of the secondary. In large institutions of the latter grade, particularly in America, are to be found the same periodical publications, athletic sports and contests, literary clubs and fraternities, the same cohesive grouping of the student body, the same affection for «Alma Mater» as are found in the colleges. In a lesser degree and on a smaller scale the large elementary schools reproduce the same life.

The drunkenness and licentiousness which used to prevail in American colleges previous to the close of the 19th century had very largely disappeared in the earlier years of the 20th. College pranks resulting in the destruction of property had become fewer in number and «rough house» tactics in secondary school life had ceased to be so fashionable. In the matter of the elimination of drinking in the colleges, America had progressed far more rapidly than the countries of Europe. Duelling such as prevailed in German universities had never taken root in America.

The establishment of academies and, later, colleges for girls in America in the 19th century led to their own development of college life and customs. These very rapidly took on the color of almost exact imitations of those which had grown up in the institutions for men. The publications, literary clubs, sororities (instead of fraternities) and even athletic contests resembled those of the men. Though drinking never prevailed to any extent, cigarette smoking among the young women in American colleges is on the increase.

As the secondary and elementary schools for boys imitated in the life and customs of the students the doings of the colleges for men, so the elementary and secondary schools for girls tended to imitate the colleges for women.

In England such close imitation of the life and customs of men's institutions by the women is not found, and on the continent of Europe the life and customs in institutions for girls is very much more restricted. In fact there is about them the same atmosphere that prevailed about the institutions for boys in the earlier Middle Ages.

Bibliography.— No one book covers the subject in all ages, in all countries and in educational institutions of varying grades. Information must be sought in treatises on education covering various periods of history and separate countries, and even separate institutions. (For an extended list of books see the bibliographies referred to in the article: EDUCATION, HISTORY OF). Information of particular value will be found in the following: Alexander, 'The Prussian Elementary Schools'; Becker-Göll, 'Charicles' (II, p. 19); Brock, 'Eton'; Brown, 'The Making of Our Higher Schools'; Capes, 'University Life in Ancient Athens'; Converse, 'Wellesley'; Corbin, 'An American at Oxford'; Farrington, 'French Secondary Schools'; Findlay, 'Arnold of Rugby'; Fulton, 'College Life'; Göll on Becker's 'Gallus' (II, p. 61); Haskins, 'Life of the Mediæval Students as Revealed by their Letters'; Hill, 'Harvard by an Oxonian'; Hinchman, 'The American School'; Jones, 'Girton'; Keppel, 'Columbia'; Mahaffy, 'Old Greek Education'; Maspero, 'Life in Ancient Egypt and Assyria'; Paulsen, 'The German Universities'; Rait, 'Life in the Mediæval University'; Rashdall, 'Universities of Europe in the Middle Ages'; Risk, 'America At College'; Russell, 'German Higher Schools'; Sheldon, 'Student Life and Customs'; Taylor and Haight, 'Vassar'; Tennyson, 'Cambridge from Within'; Von Engeln, 'Concerning Cornell'; Walden, 'The Universities of Ancient Greece'; Wilkins, 'Roman Education.'

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STUDENT OF SALAMANCA, The ('El estudiante de Salamanca'), an admirable fantastic legend in verse by the brilliant, erratic Spanish genius, José de Espronceda (1810–42). It appeared in a collection of the author's poems published in 1840, and has since appeared in popular collections of the author's lyrical productions, such as the 'Biblioteca universal,' easily procurable. The hero of the poem, Don Felix de Montemar, is a new Don Juan, who has deceived his sweetheart, the beautiful, tender and loyal Doña Elvira, and killed her brother, Don Diego de Pastraña, who sought to avenge his sister. In the profligate Don Felix, a sublime and rebellious spirit, seeking pleasure and forgetfulness of his crime in the most violent emotions, the poet has drawn a picture of himself, yet painted blacker by far than reality reveals. For Espronceda seems to take pride in astonishing by his audacity and his moral cynicism and in giving a certain air of attractive grandeur to vices which he affects but does not have. There is hardly anything in literature richer, more weird and fantastic than the description of the impious and unterrified Don Felix following the phantom who leads him along the shadowy way to the abodes of death where Don Pastraña, placing the phantom's hand in that of the satanic Montemar, tells him that at last the promise made to Elvira is fulfilled, and Don Felix, struggling in vain, expires amid countless shades of the nether world. In this exquisite poetic creation, made so largely by the many varieties of verse forms adapted to the particular situations, which render the production well nigh impossible of translation, may be divined something of the brief life of this romantic genius. The influence of Byron, Goethe and Leopardi is apparent. Capable of equaling each of these great geniuses, Espronceda in his brief career did not produce sufficient to make his poetic power so effective a reality. Consult for the poem, biography and commentary, the authoritative work by Don Patricio de la Escosura and Doña Blanca Espronceda de Escosura, 'Obras poeticas y escritos en prosa de José de Espronceda' (Madrid 1884).

James Geddes, Jr.

STUDENT SELF-GOVERNMENT.

Student self-government as an organized system is the product of modern times and of democratic ideas. In its ideal form it must not be confused with systems of government of one group of pupils by an older pupil set over them by an appointment from a teacher or the head of the school. Such systems of maintaining good order in the schoolroom and out of it existed in the Middle Ages and continued down into our own day under the names of prefectural and monitorial systems. Though these involved the government and sometimes even the teaching of students by students, there was little about them to warrant their being called self-government systems.

Strictly defined self-government of students implies the existence of a system under which the students elect their own leaders or committees to see that school or college rules are obeyed and that violators are punished. Even though in the background the supreme authority of the school or college officials is always present, it is never so apparent as to disabuse the student body of the idea that it is to all intents and purposes governing iself.

The most advanced steps in student self-government under such a definition have been taken in America. The development of a great number of extramural activities on the part of college students led quite naturally to the organization of governing bodies for such purposes almost entirely free from control by college officials. In fact in some cases the abuses of self-government in such matters became so great that the college officials and the alumni had to interfere to set things right and to impose a supervision which had not previously existed. Nevertheless the influence of self-governing action in their own affairs made for the development of self-reliance and character and both college officials and students found it was but a short step to granting the participation of the students in matters heretofore deemed the business of the professional staff of the college.

One of the first of these steps was that of self-government in the examination room. This has commonly been defined as the "honor system." Before its institution one or several college officials were deputized to guard the examination room to prevent cheating. Under the new system these officials were withdrawn and the students put on their honor not to cheat and in some institutions to report those whom they saw cheating. In general the system has come into vogue far more widely in the colleges of the South and West than in those of the Northeast. Another development has been in taking resident officials out of the dormitories or living halls of the students and placing reliance on the honor of the latter to commit no infractions of the college rules and to report students guilty of such. Still another development in some colleges has been the election by the students of a committee which takes up the matter of disciplining students and acts in consultation with members of the faculty in important questions affecting the students.

In some colleges the attempt to put these measures of student self-government through have met with failure whereas in others they have been a success. In the latter case reports would indicate that although some weaknesses are discovered, the general conditions are no worse and are sometimes a good deal better than when all of the government was directly in the hands of college officials. The most serious difficulty encountered is in getting students to play the part of informer even though the information given is secret and inviolate.

The development of self-government in American public elementary and high schools grew from somewhat different motives. At first it came into vogue through the desire on the part of teachers to teach civics or civil government in a graphic manner. Inspired by such a motive they organized their classes into school cities and States, and sometimes the whole school was organized into a great governmental institution with legislative, executive and judicial departments and an array of government officials. This organization was in many cases used as a self-governing body, but, as was the case with the colleges, some were successful and some were not. It usually depended upon how much backing and time the school teachers and officials were willing to give to it, or how much they were able to simplify and modify the structure to meet the purposes of self-government. The enthusiasm of a teacher or a principal made up for much, and in almost all cases there is evidence of a certain artificiality and a feeling that the school official is constantly behind the scenes to make the wheels of self-government work smoothly. The value of the systems is not always so much in what the students accomplish as in the development of character which such systems may produce. Teachers in high schools have sometimes reported very adversely on students coming to them from self-governing elementary schools and sometimes very favorably.

The extramural athletic and social activities of the secondary and elementary schools were for a long time exclusively in the hands of the students and thought to be no affair of the school authorities. With the great increase in their variety and importance, especially in interscholastic contests, the governing hand of the teacher or principal had to enter. A large measure of self-government, however, is left to the student body, the principal or teacher acting as an adviser and only exercising a power of veto in extreme cases. The amount of self-government in such matters is less for the secondary schools than for the colleges and is more than for the elementary school, a fact naturally due to the differences in the ages of the students.

Whether the large amount of self-government allowed to students in some of our colleges, secondary and elementary schools is going to be productive of the good results claimed for it only the future will tell. A survey of the field at present would seem to indicate that the American youth has not that law-abiding quality which is found in Old World communities where the hand of authority and the demand for obedience lies far more heavily. Opponents of the system maintain that lawlessness and failure to obey the command of governmental agencies have increased since the discipline and control of the school has been relaxed. Its supporters, however, say that such symptoms are due not to the self-government plan, but to the great preponderance of women teachers in the schools, to the heterogeneous character of our population and to the fact that in every new land where people foreign to each other in race, language and tradition lack for many years the proper ideals and common standards found in older and well-established nations.

Bibliography.— See general bibliographies under Education, History of. Much material is to be found in the files of current educational publications (consult Poole's Index) and in the proceedings of professional organizations of teachers such as the National Education Association. Consult Birdseye, 'The Reorganization of Our Colleges' and 'Individual Training in Our Colleges'; Cranson, 'Pupil Self-Government'; Fulton, 'College Life'; George, 'The George Junior Republic'; Gill, 'School City'; Morehouse, 'The Discipline of the School'; Thwing, 'A History of Higher Education in America,' 'The American College,' and 'College Administration.'

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STUDY CLUBS. See Supplemental Education.

STUFFING-BOX, *in machinery,* a contrivance for securing a steam, air or water tight joint when it is required to pass a movable rod out of a vessel or into it. It consists of a close box cast round the hole through which the rod passes, and in which is laid, around the rod and in contact with it, a quantity of hemp or other material called packing, this packing being lubricated with oily matter. The stuffing-box is used in steam-engines, pumps, on the shaft of a screw-steamer where it passes through the stern, etc. See Piston.

STUHLWEISSENBURG, stool-vīs'sĕn-boorg, Hungary (Hungarian, Szekes Fejervar, sā'kĕsh-fĕ'hār-vâr; Slavonic, Bieligrad), free city, capital of a county of the same name, 30 miles southwest of Buda. It was built in the 11th century, and during five centuries was the place where the kings of Hungary were crowned. It has declined from its former importance, and has a poor appearance, though it contains some good buildings, among which are the splendid cathedral of the Virgin Mary, the church of Saint John and the bishop's palace. It has a theological seminary, a Catholic gymnasium, a military academy and various other educational establishments. The manufactures consist of cotton and woolen cloth, flannel, leather, knives, etc. In 1543–1601 and 1602–88 it was held by the Turks. Pop. 36,625.

STUMM-HALBERG, stüm-hăl-bėrk, **Karl Ferdinand,** German manufacturer and political leader: b. Saarbrücken, 30 March 1836; d. Schloss Halberg, 8 March 1901. He studied at the universities of Bonn and Berlin and, in 1858, took up a share in the management of his ancestral estate consisting of iron works on the Saar, Neunkirchen, Dillingen and Burbach. In 1875 he became a partner and carried the works on successfully under difficulties. He led a squadron of Uhlans in the war of 1870–71, after being three years a member of the Chamber of Deputies. He was member of the Reichstag till 1881 and again in 1889. In 1882 he became a member of the House of Lords and was created baron in 1888. As member of the Reichspartei he upheld the agrarian and Socialists' policy of Bismarck. He favored the protection tariff reform of 1879 as well as the protection of the laborer, on whose behalf he did much in the iron workshops yet fighting against Social Democracy at the same time. A monument was erected (1902) in his memory at Neunkirchen.

STUMP-TREE. See Kentucky Coffee-tree.

STUMPF, stümpf, **Carl,** German psychologist and physician: b. 21 April 1848, at Wiesentheid, Bavaria. Studied at Bamberg Gymnasium and the universities of Würzburg and Göttingen. He taught in Göttingen from 1870, became professor of philosophy at Würzburg (1873), Prague (1884), Munich (1889), Berlin (1894). From 1907 to 1908 he was rector of the Berlin University. His works concerning the psychology of music are numerous, such as 'Musik-Psychologie in England' (in *Vierteljahrschrift für Musikwissenschaft* 1885); 'Tonpsychologie' (1883–90); 'Beiträge zur Akustik und Musik Wissenschaft' (1898–1913). Other notable works are 'Tafeln zur Geschichte der Philosophie' (1900–03); and his 'Philosophischen Reden und Vorträge' (1910), etc.

STUNDISTS, stŏn'dĭsts, members of a political and social faction in Russia, known also as Russian Baptists. Originally the Stundist movement was religious and would have remained thus except for government interference. The orthodox priests, aided by the police and the courts, entered upon a vigorous campaign of persecution, with the result that the Stundist movement developed into political and social radicalism. From association with their foreign brethren, the Russian Baptists gained some knowledge of the political institutions of other countries where the state did not interfere with the religious beliefs of its citizens. There were among them moderate liberals, with whom the paramount issue was the separation of the Church from the state and a constitutional government, as a guarantee of religious and civil liberty. The development of political aspirations among the Stundists brought into the ranks the most intelligent class of the Russian peasantry, whose influence spread in spite of persecution and undoubtedly was a serious factor in paving the way for the Revolution of 1917. The Stundists are strongest in Bessarabia and in Little Russia. Consult Dalton, H., 'Der Stundismus in Russland' (Gütersloh 1896) and Heard, A. F., 'The Russian Church and Russian Dissent' (London 1887). See also NIHILISM.

STUPART, Robert Frederic, Canadian meteorologist: b. near Toronto, Ontario, 1857. He studied at Upper Canada College, entered (1872) the service of the government meteorological department and served several years at the Toronto Magnetic Observatory. From 1884–85 he was meteorological observer in the Hudson Strait expedition, and became director of meteorological service and director of the Toronto Magnetic Observatory. He was elected president of the Royal Astronomical Society of Canada (1902–03), and president of the Canadian Institute (1906–07).

STURDEE, SIR Frederick Charles Doveton, English admiral: b. 1859. He entered the navy in 1871 and served in the Egyptian War of 1882; assistant to the director of Naval Ordnance, 1893–97; became captain in 1899 and commanded the British force in Samoa in that year; rear-admiral in 1908. From 1900 to 1902 he was assistant director of naval intelligence, became chief of staff in the Mediterranean fleet in 1905 and in the Channel fleet in 1907. He was made rear-admiral of the First battle squadron in 1910, and commander of the second cruiser squadron in 1912. At the outbreak of the European War Vice-Admiral Sturdee was chief of the war staff at the Admiralty. After the disastrous engagement off Coronel (q.v.), resulting in the loss of Admiral Cradock (q.v.) and three ships, Sturdee was dispatched with a squadron to deal with the German Admiral von Spee. The squadron arrived at Port Stanley in the Falkland Islands (q.v.) on 7 Dec. 1914, and early next monring, as if by arrangement, the five German battleships accompanied by two transports arrived off Port Stanley from the direction of Cape Horn. Von Spee expected to find only the remnants of Cradock's squaddon, the *Canopus* and *Glasgow,* and also intended to seize the wireless station, at which a shell was fired at 9 A.M. Half an hour later, on coming abreast the harbor mouth, he saw the strength of the hidden British squadron. He hastily put to sea, and Sturdee's command steamed out in pursuit. The running fight lasted all day, and by nightfall Von Spee had gone down with four of his ships and the two transports, only one, the *Dresden,* making her escape. That vessel, however, was sunk on 14 March 1915. See WAR, EUROPEAN: NAVAL OPERATIONS.

STURE, stoo'rĕ, **Sten,** regent of Sweden: d. 1503. He was a nephew of Charles VIII and became regent upon the death of the latter in 1470. In spite of the opposition of the nobility and the claims of Christian I of Denmark to the Swedish throne by the restoration of the Kalmar Union, he retained, with a short intermission, his position as the ruler of Sweden until his death. His reign was characterized by prosperity and intellectual progress among the people. He founded Upsala University, and introduced the art of printing into Sweden. The family of Sture became extinct in 1616.

STURGEON, William, English physicist: b. Whittington, Lancashire, 22 May 1783; d. 4 Dec. 1850. His education was begun in the army, where he received, through the aid of his officers, instruction in Latin, Greek and mathematics, which enabled him to read scientific books and to follow in particular his desire for a knowledge of electricity. His experiments begun during this period attracted attention on his settlement in Woolwich as a private citizen, and in 1823 he became widely known for his experiments with Ampère's rotary cylinders, and in the same year constructed the first soft iron electro-magnet. In 1832 he developed a machine which produced the greatest electric current then known, and during the remainder of his life was engaged in many valuable experiments. He founded the first electrical journal — the *Annals of Electricity* — in 1836. His chief writings are included in his 'Scientific Researches' (1850). He also wrote 'Experimental Researches in Electro-Magnetism, Galvanism, etc.' (1830); 'Lectures on Electricity' (1842); 'Twelve Lectures on Galvanism' (1843). Consult Smith, 'Centenary of Science in Manchester' (1850).

STURGEON, stėr'jŏn, a family (*Acipenseridæ*) of fishes, now generally considered to constitute, with or without the paddle-fishes (*Polyodontidæ*) the distinct order *Chondrostei.* Formerly the sturgeons were classified as cartilaginous ganoids, an arrangement which ichthyologists no longer find adequate. This group is considered to be one of the primary divisions of the *Teleostomi,* and the modern sturgeons to be the degenerate descendants of the more highly developed extinct forms. This degeneracy is expressed in the deficiency of the skeleton in numerous respects.

The sturgeons are bulky fishes of elongated form. The snout is conical and tapering. The mouth, which is small, toothless and protractile, is situated on the under surface of the muzzle, and is preceded by four tentacle-like filaments or barbules. The eyes and nostrils exist at the sides of the snout. The head is completely invested by ganoid plates, some of which are median, while on the body these plates are arranged in five longitudinal rows with smaller plates between. The tail is heterocercal, or unequally lobed, and is provided with bony spines along its upper margin. A single dorsal fin is present and placed far back, as are also the anal and ventral fins. Spiracles or apertures for the admission of water to the gills exist on the upper aspect of the head. The opercula or gill-covers are of large size, but imperfectly ossified and the branchiostegal rays are wanting. There are four pairs of gills and a pair of pseudobranchiæ on the opercula. The internal skeleton is chiefly cartilaginous, though the weak maxillary, premaxillary and dentary bones, serving as supports for the jaws, are ossified as are also the cerato-branchials. A persistent notochord is surrounded by partly segmented cartilaginous vertebræ. A remarkable feature of the shoulder-girdle is the presence of an interclavicle. Among features of the soft anatomy are to be noted the presence of an elaborate spiral valve in the rectum, of pyloric cæca, of a large swim-bladder communicating with the œsophagus by a duct but without any highly vascular respiratory area, of several series of valves in the bulbus arteriosus, or base of the aorta, and of distinct funnel-shaped oviducts. All of these characters separate the sturgeons from the more highly specialized spiny-rayed fishes. Two to four genera and from 20 to 50 species have been recognized by different authors, the disparity arising from the great changes undergone by these fishes in the course of their growth. All are found in the northern hemisphere and most of the species are anadromous, living in the sea except at the time of reproduction, when they migrate up the rivers to fresh water for the purpose of spawning.

The latest authorities on the North American species give six as belonging to our fauna, five of the genus *Acipenser,* and one of *Scaphirhynchops.* All of them are of more or less importance as food fishes. The common sturgeon (*A. sturio*) is common to the Atlantic coasts of the United States and Europe. This and the related species are distinguished by minute characters in the shape, sculpturing, number, etc., of the large shields, the proportions of snout, fins and other similar characters for which the reader is referred to the literature cited. On our coasts the common sturgeon is found from New England to the Carolinas, entering rivers in the spring. In the Delaware River they appear in April and remain until September, the eggs being deposited during the early summer, being forced out by the female as she rubs her belly over rocks, stubs or other hard objects to which the eggs adhere after their immediate fertilization by the male. They are blackish in color, very glutinous, about a ninth of an inch in diameter and their number very great, not less than one to two and one-half millions being produced by each large female, and the ovaries at the time of maturity are so bulky that they constitute fully one-third of the fish's weight. Although so large the sturgeon feeds almost entirely on small mollusks, annelids, crustaceans and dead animal matter which it digs from the mud with its pointed snout, detects with its sensitive tentacles and sucks in with its small toothless mouth; to a great extent it is a scavenger. At times small fishes are also devoured in considerable quantities and that it may display considerable agility is attested by its occasional leaps from the water. The sturgeon reaches a length of from 5 to 10 feet, and a weight of 500 pounds, though examples of that size are now exceedingly rare. Formerly this fish was exceedingly abundant, a fact frequently mentioned by colonial and other early writers.

In the Delaware River, where the chief sturgeon fisheries exist, it was not valued previous to the last 60 years, but when captured was thrown away or an entire fish of several hundred pounds sold for 25 cents as hog food. The importance of the fisheries dates from about 1870, but they have been prosecuted so recklessly that they have been already nearly depleted. Drift gill-nets are the chief means of capture. They are set on the flood tide and when the bobbing of the floats indicates the enmeshment of a fish, are drawn and the captive, which is singularly docile, removed. The flesh is sold fresh or smoked and is valued chiefly by the foreign population of the large cities. It brings a high average price in the market. The roes fetch a higher price and are immediately removed and worked through a wire sieve to separate the eggs, which are then placed in a brine of salt and boracic acid or similar preservative. After a sufficient treatment they are thoroughly drained and packed in oaken kegs or cans. This product is the celebrated caviar of the Russians. Vinegar seems to be no longer employed in the preparation of caviar in America. Besides using the flesh and roes for food the swim-bladders of the sturgeon are largely employed in Europe in the manufacture of isinglass. This substance is prepared by washing the sound in fresh water, and then carefully dried. The outer coat is then peeled off, the inner coat being cut into lengths or staples, which afford the isinglass. The sturgeon was celebrated among the ancient, for we find that in the palmy days of the Roman Empire sturgeons, profusely decorated with flowers, were borne in triumph to table. In the Volga, sturgeons are captured by driving piles at close distances so as to form a barrier across the river; by this barrier the fishes are forced into an enclosure, in which they are trapped and readily seized. Formerly any sturgeon captured in the Thames above London Bridge might be claimed by the lord-mayor, while one caught elsewhere might be claimed by the king as a «royal» fish. This custom doubtless arose from the high esteem in which the flesh was held by former sovereigns. Henry I is said, indeed, to have prohibited its use at any but his own table.

The white, Oregon or Sacramento sturgeon (*A. transmontanus*), is a still larger species, reaching a length of 13 feet and a weight of 1,000 pounds, found on the Pacific Coast. It is captured in considerable numbers in pound-nets and on set-lines in the Columbia and Sacramento rivers. It furnishes caviar, and smoked or frozen flesh, which is shipped East. This species is said to feed chiefly on minnows. The lake sturgeon (*A. rubicundus*) lives in the upper Mississippi Valley, in the Great Lakes and other smaller lakes of the central United States and Canada. It seldom exceeds 50 pounds in weight, but is the object of important fisheries in Lakes Erie, Ontario and Lake of the Woods. It feeds on snails, crayfish and insects. The green sturgeon (*A. medirostris*) of the Pacific is of little value as food, though not poisonous as often stated, while the Atlantic short-nosed sturgeon (*A. brevirostrum*) is disregarded on account of its small size. *Scaphirhynchops* has a broad flat snout, no spiracles, and a complete covering of bony plates on the base of the tail. Besides several Asiatic species, the white or shovel-nosed sturgeon (*S. platyrhynchus*) is common throughout the Mississippi Valley and beyond, and although seldom exceeding two feet in length is much valued for food.

The family *Polyodontidæ* or paddle-fishes are sturgeon-like fishes sometimes placed in a separate order and distinguished from the true sturgeons especially by their remarkably prolonged spatulate snouts, the absence of maxillary bones and the smooth unarmored skins. *Psephurus gladius* is found in the rivers of China, *Polyodon spathula* in the rivers of the Mississippi Valley. This remarkable fish stirs up the mud of the bottom with its long paddle and strains out the small organisms so exposed by means of its filter-like gill-rakers, and swallows them. It breeds in the ponds and bayous connected with the upper parts of the rivers or in the shallows of lakes. It is captured in seines and on set-lines and the product of the fisheries is utilized in the same manner as other sturgeons. The important centres of this fishery are along the lower Mississippi and in Lake Pepin, Minn.

The sturgeon fisheries of all parts of the country are in serious danger of being destroyed, but the above data indicate that the evils of overfishing, etc., have been most harmful in the Delaware River. Several attempts to propagate the sturgeon artificially have been made by the Fish Commission, but the peculiar difficulties resulting from the methods of the fisheries and the mode of reproduction of this fish have up to the present proved insurmountable.

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STURGEON BAY, Wis., city, county-seat of Door County, on Sturgeon Bay and on the canal which connects Green Bay with Lake Michigan by a short route and on the Ahnapee and Western Railroad. It is about 40 miles northeast of the city of Green Bay. The bay is a good harbor about eight miles long and from one to three miles wide. The city is in an agricultural region, formerly an extensive lumbering region. Sturgeon Bay exports large quantities of grain and lumber. Its industrial establishments include box factories, flour mills, foundries, machine shops, shipyards, canneries, stone quarries, etc. There is a State fish hatchery here. The city has also a public library, government lighthouses, Indian burial-ground and Peninsula State Park. Pop. 4,262.

STURGEON FALLS, Canada, town and outport of Nipissing District, Ontario, on Lake Nipissing and on the Canadian Pacific Railroad. It is 385 miles west of Montreal, and has paper and other mills. Pop. 2,199.

STURGIS, Richard Clipston, American architect: b. Boston, 24 Dec. 1860. He was graduated at Harvard in 1881, studied architecture in London, England and began practice in Boston in 1887. He was a member (1904–09) of Sturgis and Barton Company, but has since been alone. He was architect of Franklin Union, Boston, Brookline Public Library building, First National Bank building, Boston and the Cathedral, Manila, etc.

STURGIS, Russell, American architect and author: b. Baltimore, Md., 16 Oct. 1836; d. New York, 11 Feb. 1909. He was graduated at the College of the City of New York in 1856; studied architecture in Europe and practised his profession, 1865–78, retiring because of failing health. He devoted his attention to the artist societies of New York City and to writing and lecturing on art subjects. He edited the art sections of the Century and Webster's ‘International’ dictionaries and of Johnson's (later Appleton's) ‘Universal Cyclopedia’; contributed largely also to the ‘New International Encyclopædia’ and the ‘Encyclopedia Americana.’ He was editor and chief author of the ‘Dictionary of Architecture and Building’ (1901–02), and edited the department “The Field of Art” in *Scribner's Magazine* after January 1898; also issued a revised edition of Lübke's ‘Outlines of the History of Arts,’ completely revised and brought down to date (1904). He was the author of the ‘Manual of the Jarves Collection of Early Italian Pictures,’ published by Yale College (1868); ‘European Architecture, a Historical Study’ (1896); ‘Annotated Bibliography of Fine Art’ (1897); ‘How to Judge Architecture’ (1903); ‘The Appreciation of Sculpture’ (1904); ‘The Interdependence of the Arts of Design’— the Scammon Lectures for 1904 (1905); numerous critical monographs in different periodicals.

STURGIS, Mich., city in Saint Joseph County, on the Grand Rapids and Indiana and the Lake Shore and Michigan Southern railroads. It is 36 miles southeast of Kalamazoo and has manufactures of furniture, plumbers' woodwork, shears, a foundry, etc. Pop. 3,000.

STURLUSON, stoor'lā-sōn, **Snorri,** Icelandic author and politician: b. 1178; d. Reykholt, 22 Sept. 1241. He was well educated in Scandinavian history, mythology and poetry. He soon rendered himself popular by his bravery on the field and eloquence in the assemblies of the people and was elected by the unanimous voice of the people supreme judge of the island. In 1213 he composed his first poem which became widely known, a panegyric of Hako IV, king of Norway. In 1218 he paid a visit to Norway. where he was well received by Jarl Skule, who loaded him with rich presents and high dignities on the eve of his return to Iceland in 1220. In 1237, being forced by feuds to leave Iceland, he made a second voyage to Norway, where he was once more warmly welcomed by Skule, now become duke. Snorri composed some poetical pieces warmly laudatory of his patron, and promising him success in the struggle going on between him and Hako V. That prince forbade Snorri to return to his native land, but the order was unheeded, and Sturluson, being informed of the decline of the power of his enemies, returned to Iceland in 1239, and was there murdered. His principal work, which he completed about 1230, is the ‘Heimskringla’ (Circle of the World), in which he records the lives of the legendary and historical kings of

Norway down to the death of Magnus Erlingsson in 1177. It was translated into Danish by Peder Clausson, and published in Copenhagen by Olaf Worm in 1633. A recent edition is that by Jónson (1893 onward). The work has also been translated into German, Norwegian, Swedish, Latin and English (by S. Laing, 1844; new ed. by R. B. Anderson, 1889; by W. Morris and E. Magnússon, 1893–94). He composed numerous eulogistic poems on the princes and jarls whose courts he had visited; and wrote, it is believed, the first part ('Gylfa-Ginning') of the 'Snorra-Edda,' or 'Younger Edda.' See EDDAS, THE.

STURM, stoorm, **Jacques-Charles-Francois,** French mathematician: b. Geneva, 29 Sept. 1803; d. Paris, 18 Dec. 1855. He studied at the Geneva College, passing the course before his 14th year, to enter the Academy course. He became teacher to the son of Madame de Staël. In 1827 he was awarded the grand prize in mathematics and by 1829 he had propounded his great theorem «the solution of numercial equations,» which has done so much to assist in the advance of scientific research. He was successively appointed professor of special mathematics at the Rollin College (1830); was made member of the Académie des Sciences (1836), succeeding Ampère, and in 1840 he was made professor of analysis in the École Polytechnique and professor of mechanics to the faculty of sciences. Consult Liouville, 'Discourse prononcé sur la tombe de Sturm,' in *Siècle* (1855); Prouhet's 'Notice' in *Nouvelles Annales Mathematiques* (1856).

STURM, or STURMIUS, Johannes, German educator: b. near Cologne, 1 Oct. 1507; d. 3 March 1589. In 1537 he founded the gymnasium in Strassburg which attained world-wide celebrity. He was generally regarded as the greatest educator connected with the Reformed Church. Sturm's ideal in education was «to direct the aspiration of the scholars toward God, to develop their intelligence, and to render them useful citizens by teaching them the skill to communicate their thoughts and sentiments with persuasive effect.» In carrying out this ideal Sturm showed his superiority by his judicious gradation of the course of study, and by his novel and attractive methods of instruction. His influence has been potent in the German system of secondary education down to our own day.

STURM, Julius, German lyric poet: b. Köstritz in Reuss, 21 July 1816; d. Leipzig, 2 May 1896. He studied theology at Jena and was pastor at Göschitz, 1851–57 and at Köstritz, 1857–85. His poems have a decidedly religious or nationalistic trend. Among his published volumes are 'Two Roses; or, the Canticle of Love' (1854); 'Devout Songs and Poems' (1858); 'Israelite Songs' (3d ed., 1881); 'Poems of Battle and Victory' (1870); 'Mirror of the Time in Fables' (1872); 'To the Lord my Song' (1884); 'Palm and Crown' (1887); 'In Joy and in Sorrow' (1896); 'Für das Haus'; 'Lieder und Bilder'; 'Kampf und Liegesgedichte'; 'Spiegel der Zeit in Fabeln'; 'Kinderleben'; 'Immergrün'; 'Natur, Liebe, Vaterland.' Consult the biographies by Hepding (Giessen 1896) and Hoffman (Hamburg 1898).

STURT, stėrt, SIR **Charles,** English explorer: b. Bengal, India, 1795; d. Cheltenham, England, 16 June 1869. He entered the army and in 1825 went with the rank of captain to New South Wales, where in 1827 he headed an expedition into the interior of Australia, in the course of which he discovered the Macquarie, Castlereagh and Darling rivers, and in June 1830, while on a later expedition, discovered the important Murray River, which he descended to its mouth. In 1844 he discovered the stony desert in the centre of the Australian continent. He was made registrar-general and colonial secretary of South Australia, but his exposure during his expeditions soon rendered him totally blind and he returned to England, where he was knighted just prior to his death. He published 'Two Explorations into the Interior of Southern Australia in 1828–31' (2 vols., 1834); 'Narrative of an Expedition into Central Australia in 1844–46' (2 vols., 1849). Consult Sturt, N. G., 'Life of Charles Sturt' (London 1899).

STUTTERING, faulty articulation which results in defective speech. See STAMMERING.

STUTTGART, Ark., city of Arkansas County, 50 miles southeast of Little Rock, on the Chicago, Rock Island and Pacific and the Saint Louis Southwestern railroads. It has rice mills, pump and screen factories, iron and brass foundries, a saw mill and a handle factory. There is a large trade in agricultural produce. Pop. 2,740.

STUTTGART, stoot'gärt, Germany, capital of Würtemberg, in the basin of a broad valley, enclosed by vine-clad or wooded hills, near the Neckar, 40 miles southeast of Carlsruhe. Many of the important buildings are grouped near the central Palace square; chief of these are the old and new Schlösser or Palaces, of the 16th and 17th–18th centuries, respectively, with extensive and beautiful grounds, embellished by statuary and fountains. Other interesting features are the numerous princely palaces; the Königsbau, with colonnades; Akademie; the Gothic churches of Saint Leonard's, Saint John and the Hospital Church; the Queen Olga buildings, on the north side of Castle square, the National Industrial Museum, with lofty cupolas; the Liederhalle, containing an enormous hall; the new town-hall, Peace Church, Saint Nicholas, etc. Other interesting features are the numerous collections of antiquities, art, numismatics, archives, conservatory of music, chemical laboratory, schools of art, science and commerce; and the magnificent royal library, which contains about 500,000 volumes and the largest collection of Bibles in the world (7,300). Stuttgart is one of the most important publishing centres in the world and has a constantly increasing trade. The manufactures include textiles, chemicals, furniture, carriages, paper, jewelry, bells, cigars, chocolate, pianos, pigments, leather, etc. There is a large trade in hops, cloth and horses. Near the Neckar, at Berg, there are mineral springs, and Carnstatt is a watering-place near the town, connected with it by tramway. Many monuments of German heroes and celebrities stand in the various squares of the city and in the parks. The town is on the line of several railways. It stands on the site of an

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ancient monastery. In the 15th century it became the residence of German princes and was greatly improved, being designated the official capital in 1482. Art and science were introduced in the 19th century. Stuttgart was the home of the philosopher Hegel and Hauff, the art critic. The city is governed by an overburgomaster, assisted by two advisers and a council. Pop. 286,218. Consult Klaiber, 'Stuttgart (in 'Europäische Wanderbilder' (Zürich 1892) and Widmann, 'Wandering durch Stuttgart und Umgebung' (Stuttgart 1896).

STUYVESANT, stī'vĕ-sănt, **Petrus,** Dutch director-general of New Netherland: b. Holland 1592; d. New York, August 1672. He served in the war in the West Indies, became director of the colony of Curaçao, and, having lost a leg in an unsuccessful attack on the Portuguese island of Saint Martin, returned to Holland in 1644. In 1645 he was appointed by the Dutch West India Company director-general of New Netherland, succeeding William Kieft, who had involved the settlers in a war with the Indians, and created general disorder. He did not arrive until 11 May 1647, when he commenced a vigorous and often arbitrary administration, conciliating the savages and thoroughly restoring order. In 1650 he arranged at Hartford with the New England commissioners a boundary between the Dutch and English territories, previously undefined and a cause of frequent disputes. He was also involved in trouble with the Swedes on the south. In 1651 the Dutch built Fort Casimir on the Delaware, but the post was captured by Rising, governor of New Sweden, in 1654. To revenge this, Stuyvesant in 1655, with seven vessels and about 700 men, sailed into the Delaware, and made a conquest of the whole settlement of New Sweden, calling it New Amstel. Ten years of peace followed, disturbed only by the growing jealousy of the English, and by the civil discontents which the haughty character of Stuyvesant's administration provoked. In 1653 a convention of the people, consisting of two deputies from each village in New Netherland, met and formulated demands that «no new law shall be enacted but with the consent of the people; that none shall be appointed to office but with the approbation of the people; that obscure and obsolete laws shall never be revived.» This assembly was dissolved by Stuyvesant, who comanded the members to disperse, saying: «We derive our authority from God and the company, not from a few ignorant subjects.» The encroachments of the New England colonies at last induced Stuyvesant himself to lay his remonstrances before the convention of the united colonies at Boston, but he met with little favor. A second embassy to Hartford had no better success. The Connecticut agents made exorbitant claims to territory by virtue of the royal patent. In 1664 Charles II granted to his brother, the Duke of York, the territory from the Connecticut to the shores of the Delaware, and in August an English fleet under Capt. Richard Nicolls appeared in the bay and demanded the surrender of the city. The municipality insisted on yielding. After holding out for a short time, the governor at last consented, and the city was surrendered 3 Sept. 1664. After the capture Stuyvesant in 1665 left to report to his superiors in Holland, but afterward returned, spending the remainder of his life on his farm or bouwerij (whence the name of the street called Bowery). He lies buried in the vaults of Saint Mark's Church. The semi-burlesque account of him by Irving in the 'Knickerbocker's History' is well known. Consult Abbott, J. S. C., 'Peter Stuyvesant' (New York 1898); Tuckerman, Bayard, 'Peter Stuyvesant' (ib. 1893); Van Rensselaer, Mrs. S., 'History of the City of New York in the Seventeenth Century' (2 vols., ib. 1909); O'Callaghan, E. B., 'The History of New Netherland' (ib. 1848).

STY, or **STYE,** an inflammatory swelling about the follicle of an eyelash, known in surgery as hordeolum. It resembles a grain of barley, and is strictly only a little boil which projects from the edge of the eyelid, mostly near the great angle of the eye. It is of a dark red color, much inflamed, and much more painful than might be expected, considering its small size, partly owing to the vehemence of the inflammation, and partly to the exquisite sensibility and tension of the skin which covers the edge of the eyelid. On this account a sty often excites fever and restlessness in delicate, irritable constitutions; it suppurates slowly and imperfectly; and when suppurated has no tendency to burst. It generally bursts in a few days, however, though it is generally better to puncture it. Warm-water dressings with lint and oiled silk should be applied.

STYLE, (1) *in chronology,* see CALENDAR; (2) *in art,* see PAINTING; (3) *in architecture,* see ARCHITECTURE.

STYLITES, stī-lī'tēz. See PILLAR SAINTS.

STYLOBATE, *in architecture,* the substructure of a Greek temple below the columns, sometimes formed of three steps which were continued round the peristyle, and sometimes of walls raised to a considerable height, in which case it was approached by a flight of steps at one end.

STYLUS. See PEN.

STYPTIC, an application for checking the flow of blood or closing the aperture of a wounded vessel. Oak-bark decoction, gall-nuts in powder or infusion, matico and turpentine are styptics derived from the vegetable kingdom; and from the mineral are derived salts of iron, the sulphates of copper and zinc, the acetate of lead and the nitrate of silver.

STYRAX, the typical genus of the family *Styracaeæ,* graceful, spreading shrubs or trees, with entire or serrate leaves, and bearing white five-parted flowers in drooping racemes, often very showy and fragrant. *Styrax benzoin* of the East Indies and adjacent Asiatic coasts yields, when the bark is wounded, a yellowish-brown resin, which, when heated or rubbed, gives out a balsamic vanilla-like odor. It is a favorite ingredient of incense, perfumes and cosmetics; also a stimulating and healing drug and one of the principal constituents of court-plaster. *Styrax officinalis,* found in Asia Minor and Syria, has a resinous bark and flowers of orange-blossom-like sweetness. This species formerly yielded the fragrant solid resin, vanilla-scented, and like benzoin, known as storax, once much used in incense, but which has now disappeared from commerce, its place being taken by the "liquid" storax, furnished by *Liquidambar*, which also was anciently known. *Styrax americana* is a small shrub, of the southern United States, which has slender branches, and, in spring, drooping solitary or racemed, bell-shaped flowers, having a faint fragrance, and nearly hidden by the small, oval leaves which are nearly smooth. *S. grandifolia* is more pubescent, has larger leaves and more fragrant flowers. Certain Japanese species are in cultivation, and are hardy as far north as Massachusetts, such as *S. japonica* and *S. obassia*.

STYRIA, stĭr'ĭ-ạ, Austria, a province, formerly duchy; area, 8,662 square miles. It is traversed by three Alpine ranges, whose highest points reach in the Grimming at the northwest, and the Eisenhut at the southwest, an elevation of 7,400 and 7,646 feet respectively. The ranges are penetrated by many valleys of different extent; the only level land is at the southeast. Styria belongs wholly to the basin of the Danube, and is drained by the Enns, Mur, Drave and Save. The mountain lakes lie amid beautiful scenery. There is much barren land, and about 20 per cent of the total area is arable; vineyards flourish in certain districts. Fruits abound, and hemp, flax and the poppy are grown extensively. The forests and mines are the staples of wealth, and their products constitute the chief exports. The minerals comprise gold, silver, copper, lead, zinc and the finest quality of iron — besides sulphur, salt and alum. The iron manufactures are the most important, including scythes, swords, rails, sheet-iron, wire, hardware, etc. Other manufactures are glass, tobacco, liquors, beer and paper. Pop. about 1,450,000. The population is about 98 per cent Roman Catholic. Graz, the capital, has a population of 151,181. Other large cities are Marburg, Eggenberg and Leoben.

In Roman days Styria was divided between Pannonia and Noricum and was inhabited by the Taurisci, a Celtic people. In the various migrations that swept over Europe Styria was crossed by Visigoths, Huns, Ostrogoths, Langobardi, Franks, Arars, Slavs, etc. The Slavs predominated after the 6th century A.D. It was included in the great duchy of Carinthea but was recognized as a separate mark in 1056. It became a duchy about 1192, when it passed to the house of Austria. In 1282 it passed to the Hapsburgs. Consult 'Die Oesterreichisch-ungarische Monarchie in Wort und Bild' (Vol. VII, Vienna 1890); Gsell-Fels, Thomas, 'Die Steiermark' (Munich 1898): Imendörfer, Benno, 'Landeskunde von Steiermark' (Vienna 1903); von Machar, Albert, 'Geschichte der Herzogtums Steiermark' (9 vols., Graz 1844–74); Rosegger, P. K., 'Das Volksleben in Steiermark' (Leipzig 1895); Mayer, F. M., 'Geschichte der Steiermark' (Graz 1898).

STYX, stĭks, the name of a river of the infernal regions, in the mythology of the Greeks and Romans. The real Styx was a stream in Arcadia, which is now called the Mauraneria, or Black Waters, and also the Drako-neria, or Terrible Waters, and which was and is considered injurious to men and beasts. Souls going to the infernal regions were, according to the ancient myth, ferried across the Styx by Charon.

SU-CHAU, soo'chow', China, the capital of the province of Kiang-su, situated on the Grand Canal east of Lake Tai-hu, and 50 miles west of Shanghai. The city is surrounded by walls 30 feet high, and the inner portion is intersected by numerous natural and artificial waterways which communicate with the larger channels connecting the city with the Yang-tse-kiang, Lake Tai-hu, Shanghai and Hang-chau. Su-chau is the seat of the provincial college, and contains several interesting pagodas. In the vicinity stands the ancient temple of Hu-kiu-shan. The inhabitants manufacture silks and other cloths, and fine carved and lacquered articles. The city was made a treaty port in 1896 by the Treaty of Shimonoseki. Pop. estimated at 500,000.

SUAKIN, swä'kĭn, or **SUAKIM**, Nubia, a seaport on the coast of the Red Sea, consisting of two parts joined by a causeway, one part occupying the shore of the mainland, the other the rocky island in the bay. It is the principal town of the district of the same name, in the Sudan. The natives live at El-Keff, the section on the mainland, and here stands the bazaar — a scene of bustling activity, also the barracks occupied by Anglo-Egyptian troops; beyond are the fountains surrounded by date-groves and orchards. The natives live in tents. The principal manufactures are silver ornaments, knives, spear-heads and leather-work. Trade is considerable, and the chief exports include the above-mentioned articles, besides ivory, gums, millet, cattle, hides and gold. The imports: durra, cottons, flour, sugar, rice, ghi, dates and coal. This is a starting-point for African pilgrimages to Mecca. The vicinity was the battlefield of the allied British and Egyptian forces against the Mahdi and his Dervish followers. It was for many years a slave port. Pop. about 10,500.

SUAREZ, swä'rĕth, **Francisco**, Spanish theologian: b. Granada, 1548; d. Lisbon, 1617. He was one of the most eminent scholastic and polemical writers of the Roman Catholic Church. He entered the Society of Jesuits in 1564, and soon became professor in succession at Valladolid, Rome, Alcalá and Salamanca. In 1597 Philip II appointed him principal professor of divinity at the University of Coimbra, a position he held until his death. The most recent edition of his works was completed in Paris in 1860.

SUAREZ MUJICA, Eduardo, Chilean diplomat: b. Santiago, 1850. He was educated at the Santiago University and became (1882–1888) Acting Secretary of Foreign Affairs, governor of Atacama (1901–03), member of Congress (1903–09) and Minister of Justice and Public Instruction (1908). In 1909 he was made Minister to Mexico and Cuba, then (1911) Minister and (1914) Ambassador to the United States. He was a member (1915) of the Niagara Falls Pan-American Conference to discuss and settle the imbroglio with Mexico.

SUB-DEACON, the lowest step in major orders in the Roman Catholic Church and the highest of the minor orders among the Greeks. In the Roman Catholic Church sub-deacons prepare the sacred vessels and the bread and wine for Mass, pour the water into the chalice at the Offertory and sing the Epistle; in the Greek Church they prepare the sacred vessels, and guard the gates of the sanctuary. There are no sub-deacons in the Protestant Episcopal Church.

SUBCONSCIOUSNESS, a state of the mind or a process of cerebration similar to those mental states and processes of which we have consciousness, though of this state or process we are unconcious. See Consciousness.

SUBLIMATION, a chemical process by which volatile solids which do not melt are vaporized by heat, and again condensed in a solid form, without passing through an intermediate liquid phase. The operation is commonly conducted either for the purpose of purifying certain substances and disengaging them from extraneous matters, or of reducing them into vapor and combining them while in that form. As all fluids may be volatized by a sufficient degree of heat, and consequently may be separated, in most cases, from fixed matters, so various solid bodies are subjected to a similar treatment. The substance formed by the process of sublimation is called a sublimate. The principal subjects of this operation are volatile alkaline salts, neutral salts, composed of volatile alkali and acids, as sal-ammoniac, arsenious acid, benzoic acid, mercurous chloride, indium trichloride, anthracene, iodine, camphor and sulphur. In some cases, by applying the heat under pressure a substance which usually sublimes before melting may be first melted and then distilled as in the case of liquids. For instance camphor sublimes at any temperature below 350° F. If confined under pressure it will melt and boil at 400°. However if the vapor from the boiling liquid is passed into a vessel of lower temperature it does not deposit as a liquid but as a solid. Sulphur melts to a liquid in the process of sublimation but does not pass through a liquid state in condensing. See Distillation; Evaporation.

SUBLIME, The, that which, in the works of nature or of art, is grand and awe-inspiring. Longinus, the eminent philosophical critic (3d century), in his work ‹Peri Hypsûs,› ‹Of Sublimity,› characterizes the sublime in literary composition as that which «fills the reader with a glorying, and sense of inward greatness»; but he does not inquire into the nature of the sublime in general. Burke finds the essence of the sublime to consist in terror, acting whether openly or latently. Blair sees the cause of the feeling of pleasurable elation excited by the sublime, a mighty power or force; Kaimes in height or elevation; according to Sir William Hamilton the emotion produced by the sublime is a mingled feeling of pleasure and pain — pleasure in the consciousness of strong energy, and pain in the consciousness that this energy is vain. He distinguishes three phases of the sublime, the sublime of extension or space, of intension or power, and of protension or power, and cites the following passages from Kant as admirably illustrating the sublime in each of these three forms:

"Two things there are, which, the oftener and the more steadily we consider them, fill the mind with an ever new, an ever rising admiration and reverence — the Starry Heaven above, the Moral Law within. Of neither am I compelled to seek out the reality, as veiled in darkness, or only to conjecture the possibility, as beyond the hemisphere of my knowledge. Both, I contemplate, lying clear before me, and connect both immediately with my consciousness of existence. The one departs from the place I occupy in the outer world of sense; expands beyond the bounds of imagination this connection of my body with worlds lying beyond worlds, and systems blending into systems; and protends it into the illimitable times of their periodical movements — to its commencement and continuance. The other departs from my invisible self from my personality, and represents me in a world, truly infinite indeed, but whose infinity can be tracked out only by the intellect, with which also my connection, unlike the fortuitous relation I stand in to all worlds of sense I am compelled to recognise as universal and necessary. In the former, the view of a countless multitude of worlds annihilates, as it were, my importance as an animal product, which, after a brief and that incomprehensible endowment with the power of life, is compelled to refund its constituent matter to the planet — itself an atom in the universe — on which it grew. The aspect of the other, on the contrary, elevates my worth as an intelligence even without limit; and this through my personality, in which the moral law reveals a faculty of life independent of my animal nature, nay, of the whole material world; at least, if it be permitted to infer as much from the regulation of my being, which a conformity with that law exacts; proposing as it does, my moral worth for the absolute end of my activity, conceding no compromise of its imperative to a necessitation of nature, and spurning in its infinity, the conditions and boundaries of my present transitory life." See Æsthetics.

SUBLIME PORTE, pōrt, or **OTTOMAN PORTE,** the common term for the Turkish government. The chief office of the Ottoman Empire is styled Babi Ali, meaning the High Gate, from the gate (bab) of the palace at which justice was administered; and the French translation of this term being Sublime Porte, hence the use of this word. See Turkey.

SUBMARINE CABLES. See Cable, Submarine.

SUBMARINE FORESTS are remains of forests found submerged beneath the present sea-level, and either not at all exposed or exposed only at low tide. They occur on all coasts, and indicate either a subsidence and submergence of the land after the trees had grown to their present size, or an encroachment of the sea and removal of a barrier which separated a low-lying forested area from the sea, which then submerged this area. Submerged trees are known on the Maine, Massachusetts and New Jersey coasts, as well as elsewhere in this and other countries.

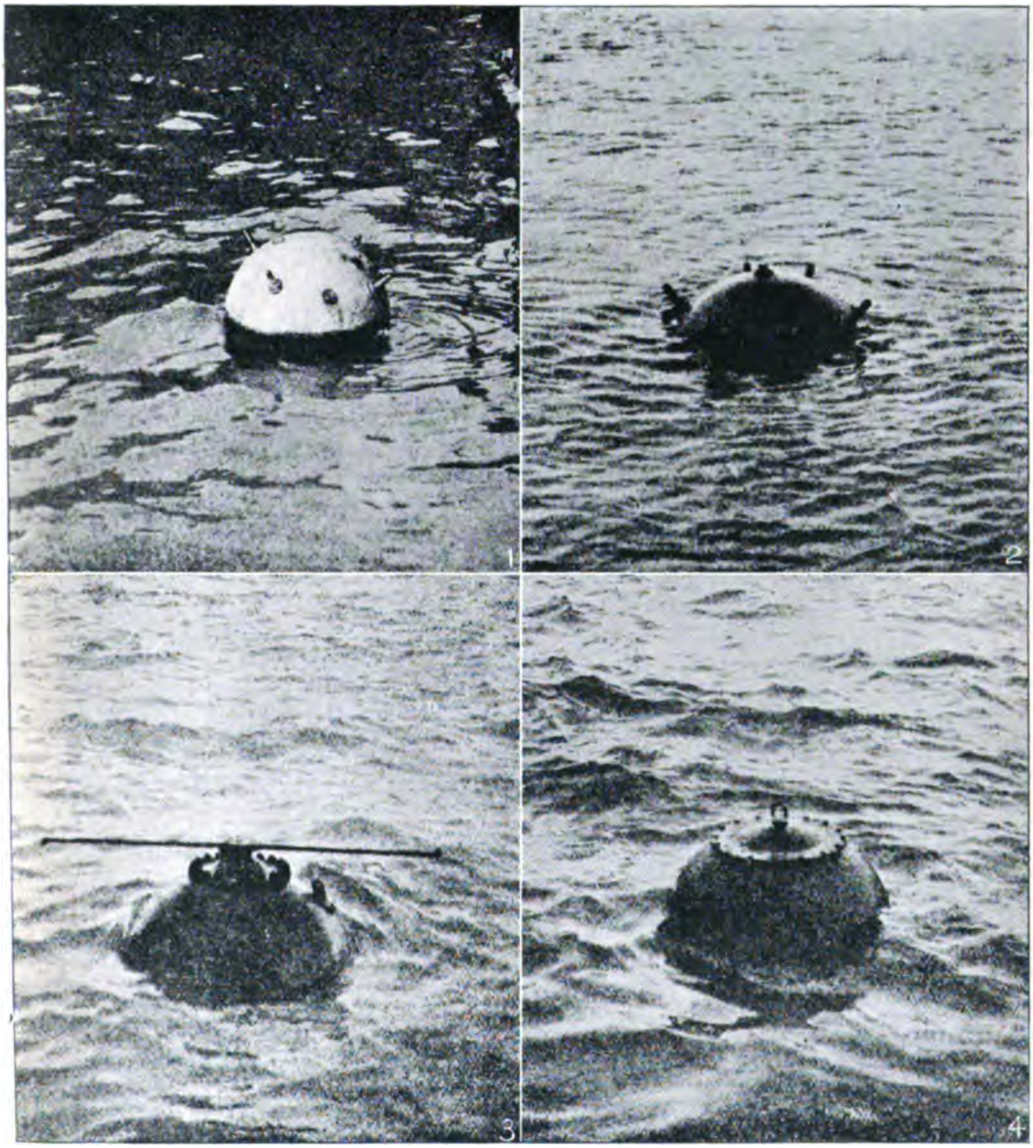
SUBMARINE MINES. The Russo-Japanese and the European wars demonstrated that the most deadly weapons of seacoast and naval warfare are the submarine mine and torpedo. A single submarine mine exploded at the proper time will disable or sink the largest battleship. The Turkish Coast artillery in closing and keeping closed the Dardanelles was pitted against the persistent and combined attack of the Allied fleets of Great Britain, France and Russia. Submarine mines are principally used in defensive operations within harbors, whereas torpedoes are primarily an element of offensive warfare by warships. Mines are generally classed as fixed and floating. The fixed or stationary submarine mine is fired by contact, electricity, timing device or fuse. Such mines, which are extensively used by all navies, are rugged in design and may contain large charges of explosives. They are placed in position by submarines and other especially equipped mine-laying vessels. Such mines are provided with anchoring devices and are deposited, if possible, in harbors and channels of the enemy or in the paths of ocean travel. Floating mines differ from fixed mines in that they are unanchored, and unless guard boats are at hand to warn friendly vessels of their proximity, may be as dangerous to friend as to foe. Such mines must be, according to the laws of war, designed to become inoperative within a few hours after being set adrift. The German floating mines were often cast adrift in pairs, connected by a line about 100 feet long. If a ship runs between the two mines they are drawn alongside the ship and exploded. Contact depth mines, which rise to the surface if failing to contact, are sometimes used with telling effect. The essence of the depth charge is that it explodes in the vicinity of the submarine or other craft, in case it fails to strike the boat itself. The use of the contact depth mine presupposes the necessary accuracy to strike the target. The high-explosive mines used by the Germans and other belligerent powers, known as submerged contact mines, when first put in place were so anchored that they were held at a certain distance below the surface of the water. It was intended that they should remain invisible and be exploded when struck by any vessel that might come in contact with them. Such mines may be removed by various methods of dragging or sweeping, such as by sinking a long cable, each end of which is attached to a tug, and thus dragging a suspected locality.

Submarine mines, fixed and floating, are of three different kinds: (1) *Observation mines,* fired from shore, when a ship is judged to be within effective range of the explosion; (2) *Automatic mines,* which are self-firing when struck by a ship; (3) *Electrical contact mines,* which, on being struck by a ship, give notice to an operator on shore, who, by the throw of a switch, fires the mines. As a rule the submarine mine consists of a metal case, filled with high explosives and fitted with a fuse that may be fired automatically, or at will by an operator located at some distant point. In shallow water the mine is laid on the bottom and is known as a ground mine. When the depth is so great as to interfere with the destructive force of the explosion, the explosive is carried in a buoyant cylinder or sphere, which is anchored to the bottom by a length of cable which causes it to float at the proper depth to be struck by a passing ship. The mines (the type in general use being the electro-contact mine) are usually planted in rows across the channel to be defended, the mines in successive rows being «staggered,» so that if a vessel should pass through the first row it must inevitably strike one or more in the later rows. They are planted in what is known as «grand groups,» which consist of 21 mines in groups of three. Some distance in the rear of the line of mines there lies on the bottom of the channel a grand junction box, from which seven cables spread, each leading to a triple junction box, which in turn controls its small group of three mines. From the grand junction box, also, the multiple cable winds its way to the switchboard connection in the operating-room on shore. The grand junction box is placed at the centre of the line of mines and about 100 feet to the rear. The triple junction boxes are laid in a straight line at intervals of 300 feet; from each of these boxes separate cables lead to each of three mines, the mines, 21 in all, being spaced 100 feet apart, in a line which extends for 2,000 feet across the channel. Each mine is anchored by a cable to an anchor, the length of the cables being such that each mine will float at a depth of 10 or 12 feet below the surface of the water. By an ingenious arrangement, one, three or the whole grand group of mines can be fired, either from the operating-room ashore, or by contact with a ship, all at the will of the operator. No mine field is complete, or can ever be thoroughly effective, unless it is protected by rapid-fire guns. It is possible for small boats, launches, etc., to be sent forward ahead of the ships, and set off the mines by exploding large charges of dynamite in the mine field. If the mines are within the «sympathetic radius» of the explosions, they will be exploded by the shock. The most effective protection against such countermining, as it is called, is by flanking the field with batteries of rapid-fire guns.

In the European War, the outstanding anti-submarine offensive project was the closing of the North Sea by a mine barrage extending from the Orkney Islands to the territorial waters of Norway, together with a barrage across the Straits of Dover. The plan to close the North Sea, and thereby deny enemy submarines free access to the Atlantic from German bases, had its inception in the United States Bureau of Ordnance in April 1917, immediately following the entrance of the United States into the war. At this time there had not been developed anywhere a type of mine suitable for the Scotland-Norway line, whereon the depths of water are as great as 900 feet and where a prohibitive number of mines of the then existing type would have been required to mine this line from the surface to a depth of 250 to 300 feet. A special mine-loading plant, with a capacity of more than 1,000 mines a day, was established near Yorktown, Va., by the Navy Department, in accordance with Congressional authorization, about 11,000 acres of land having been secured for the purpose. An immense number of mines were stowed at this depot, and it included a mine-loading plant, a mine-assembling plant and storage for a large amount of high explosives. More than a score of cargo vessels were placed in service as mine carriers to transport mines to Europe. Many mine layers and auxiliary vessels were fitted out and assigned to the execution of the project. The manufacture of the large number of mines required was a work of unprecedented magnitude and necessitated unusual methods. It was clearly impossible, in the time available, to manufacture the mine as a whole in any plant; therefore, the mine was divided into its many component parts and the parts were separately produced in a large number of industrial factories throughout the country.

The submarine mine was invented by Bushnell in 1777, improved by Fulton in 1812, further improved by Colt by the addition of the electric element in 1863, carried forward to a complete and practical system of mine defense by Gen. Henry L. Abbott, United States army, and since 1901 further perfected by the United States Coast Artillery corps in its use to the present efficient system of submarine defense of harbors, the planting and exploding of the mines at the right time and with precision be-

SUBMARINE MINES



TYPES OF BRITISH AND GERMAN MINES

1 German Mine.— Note the dangerous horns on top of mine

2 German Mine.— Note the dangerous horns on top of mine

3 British Mine.— Note the dangerous bar at top of mine

4 British Mine.— In this type the dangerous bar is at the bottom of the mine

ing a most difficult problem, the mathematical features of which are very exacting. See Naval Mines and Torpedoes.

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SUBMARINE PHOTOGRAPHY, a process of taking photographs under water discovered by Dr. L. Boutan, professor of zoology at the University of Paris. He has made successful experiments, to the depth of several hundred feet, on the coast of France and in the waters of the Mediterranean. Dr. Boutan in taking these photographs wears the regular diver's suit and extra heavy leaden shoes, so as to get a good foothold on the bottom of the sea. He uses the ordinary outfit of a photographer, with the exception that he has it all protected by water-proof coverings. He places his Leyden jars in a barrel which is surmounted by a bell glass provided with the necessary lamp. The latter is a spirit lamp to which is attached a receptacle for the magnesium powder connected with the usual pneumatic ball and tube. The photographs are taken by the instantaneous flash which follows the scattering of powdered magnesium into the flame. He has a branch tube connected with the pneumatic ball which forces a puff of air into the powder and carries it into the flame, exposing the lens at the moment of maximum light. The pictures taken at the bottom of the sea by this process show no material difference from those produced in the ordinary way by the instantaneous method, with one exception, that the negatives have a peculiarly soft tone. Since Dr. Boutan's accomplishment many others have succeeded in taking under-water pictures of great interest, which from time to time have ornamented pages of the magazines. One enterprising moving picture concern established a submarine outfit in a locality where sharks were common, and actually reproduced excellent views of a combat between a naked pearl diver and a shark, in which the intrepid diver neatly disposed of the great fish with a long dagger.

SUBMARINE SIGNALING. Submarine signaling is the art of producing sound waves in water and of transforming them into air waves so that they can be heard.

The art of submarine signaling has been directed entirely toward safeguarding lives and property at sea. Sound waves can be transmitted through water from a suitable source of sound and heard with well designed receiving apparatus at greater distances and with greater certainty than is possible through air with any sound-making device that has ever been produced. This fact gave the incentive to those who originally undertook the development of this art. Later, as the knowledge of submarine signaling increased, it has become possible to determine with considerable accuracy, from a ship moving or at rest, the direction from which the sound is coming and even the distance between the ship and the sound-producing device. Moreover, the receiving devices have been so far perfected that it is not necessary that the source of sound should be made artificially. The receiving devices can now be made in such a way that the noises of invisible ships moving through the water can be heard and the position of the moving ship relative to the listener ascertained. With the latest forms of submarine signaling devices it is possible to send and receive telegraph messages transmitted by sound waves through the water. It must be appreciated that no wires connect the sending and receiving stations. Submarine signaling is wireless communication using compressional or sound waves in water as the means rather than the transverse ether waves used to-day in what is commonly called wireless transmission.

History.—It had been well known for nearly 75 years that sound waves were transmitted through water in the same manner as through air, but to greater distances and with greater velocity (velocity of sound waves in air about 1,040 feet per second; in sea water about 4,900 feet per second). A number of inventors prior to about 1900 had suggested or patented devices for making or detecting submarine sounds. No consistent or real progress was made until

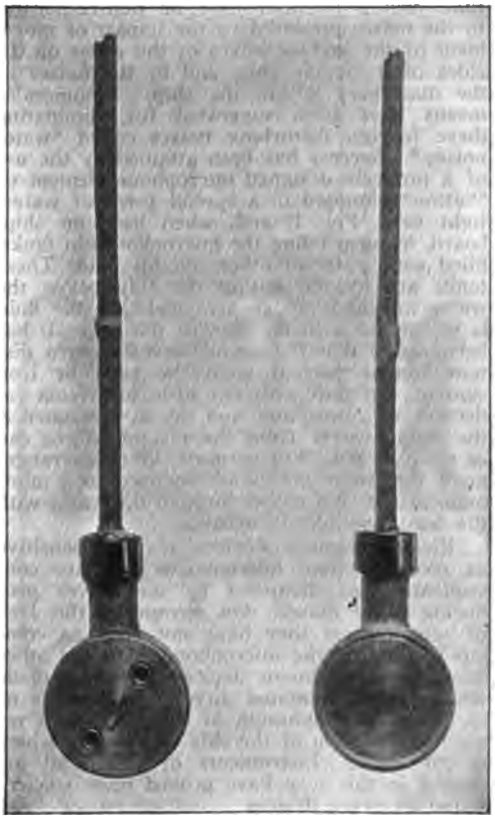


Fig. 1.—Submarine Signaling.

in 1898 a group of investigators attacked the problem. These investigators and their successors, associated in the Submarine Signal Company, have carried the art to its present high degree of usefulness. A few of those who have made material contributions to the advancement of the art are Arthur J. Mundy, Elisha Gray, J. B. Millet, Lucian I. Blake, E. C. Wood and Reginald A. Fessenden.

Receiving Devices.— The earliest sound receiving device for use in water was employed by Colladon and Sturm in experiments made by them in Lake Geneva in 1823. The sound receiver was a large ear trumpet, the small end of which was placed in the observer's ear. The large end was closed with a thin plate and was placed under water. Modifications of this early form are in successful service to-day, but the receiver most commonly used to-day is an electrical current varying device similar in principle to the telephone transmitter generally used on land lines.

One of the problems in submarine signaling which has been most difficult of solution was to find a way by which the sound-receiving device should be responsive to the noises produced by the distant source and, at the same time, would be insensitive or non-responsive to the noises produced by the impact or movement of the surface waves of the water on the sides of a moving ship, and by the noises of the machinery within the ship. Innumerable means have been suggested for eliminating these foreign disturbing noises called «water noises.» Success has been attained by the use of a properly designed microphone element or «button» mounted in a special form of watertight case, Fig. 1, and, when used on shipboard, by suspending the microphones in tanks, filled with water or other suitable fluid. These tanks are located within the ship below the water line and are so arranged that the fluid is in contact with the skin of the ship. It has been found that the sound waves from a distant source pass through the steel or iron skin of the ship with but little loss from reflection or absorption and, as a consequence, the sound waves from the distant source can be easily heard. Furthermore, by this arrangement the water noises are reduced to a minimum as the ship passes through the water with the least possible disturbance.

Electro-magnetic devices are less sensitive as receivers than microphones and are consequently less disturbed by the waves producing water noises. On account of this lack of sensitiveness they have not been as commonly used as the microphone. On the other hand, electro-magnetic devices have been made which can be mounted directly in the side of the ship, the diaphragm of the instrument replacing a portion of the skin of the ship which is cut away. Instruments of this kind arranged in this way have proved most efficient sound-receiving devices.

Sound-Producing Devices.— The earliest sound-producing device was a bell struck under water. Innumerable other means of producing sound have been suggested, tried and abandoned. Water sirens, subaqueous explosions and similar methods have never been brought to a degree of perfection which has made commercial use possible. The submarine bell has remained up to the present time, with the exception of the Fessenden oscillator to be later described, the most serviceable form of submarine sound-producing device.

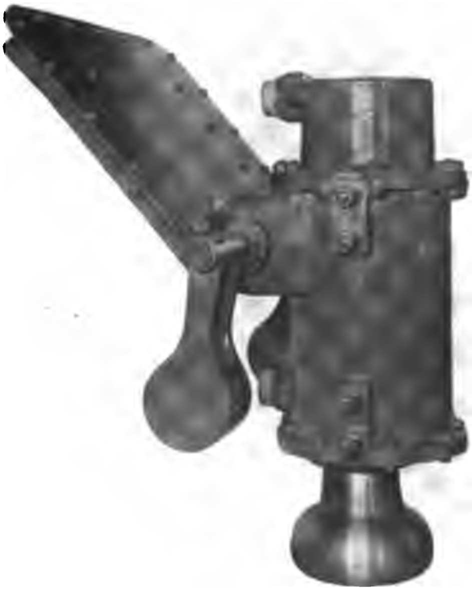
The development of a mechanism by means of which a submarine bell can be operated commercially in all weathers and for long periods of time has been very difficult. The problem has, however, been solved and several forms of submarine bells are now made to meet service requirements. One form, shown in Fig. 2, uses the movements of the surface waves to give the power required to strike the bell. In this form the bell and striking mechanism are supported at the requisite depth from a buoy or float. A wing, platform or «vane» is hinged to the sides of the bell case containing the striking mechanism, and is so counterbalanced that, as the bell case rises and falls with the waves, the differences in the movements of the bell case and vane cause a powerful spring within the bell case to be compressed and, when fully compressed, to be released. The released spring draws up the striker of the bell and causes a sharp blow to be struck. The bell mechanism is such that, whenever there is wave motion, the bell is operated at frequent intervals. Bells thus made can be kept in successful operation for considerable periods of time without attention and without any expense for the power consumed. The complete bell mechanism is so designed that corrosion, especially from sea water, is reduced to a minimum and, as all of the parts within the bell are immersed in oil, the wear upon the moving parts is small.

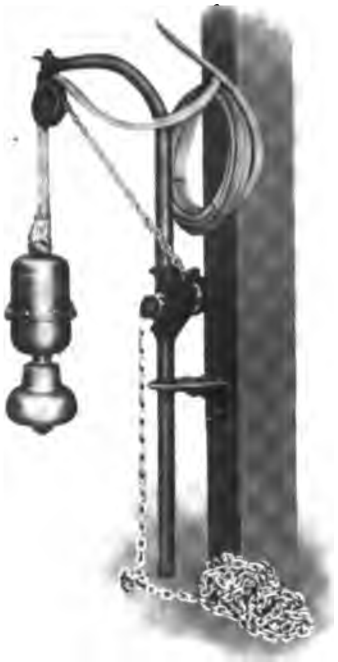
This form of submarine bell is the distinctive feature of the art of submarine signaling. The bell is supported from a buoy moored in places where there is no lightship or where it is practically impossible to obtain any other form of power with which to actuate the signaling device. The bell stroke is powerful enough to be heard at all times much farther than the uncertain signals that might be produced in the air by a mechanism operated by the energy derived from the motion of the ocean. The submarine bell can be used without requiring the attendance of an operator and in places where it is impossible to utilize wireless apparatus employing ether waves. Submarine bells of this type are to-day located at many points of danger on the coasts of most maritime countries and the number of bells in service is increasing.

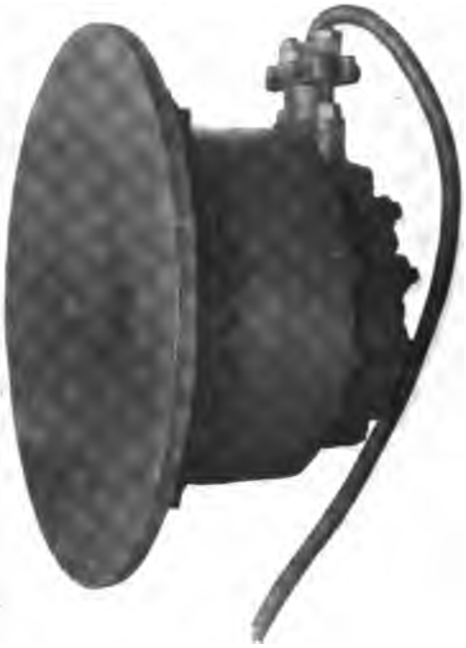
Another form, shown in Fig 3, of submarine bell has been designed for use from lightships. The blow of the striker upon the bell proper in these bells is produced by compressed air derived from an air compressor on the lightship. When signals are to be sent, the pneumatic bell is suspended from the side of the lightship and the compressed air is delivered to the bell through a hose. By a simple arrangement, the compressed air can be admitted by the normal operation of a key or automatically. Thus code signals, giving the number of the lighthouse station, can be sent out during the time the bell is required for operation.

Other forms of submarine bells are available for special conditions. Thus for service on buoys in rivers or other places where there is insufficient surface movement of the water

SUBMARINE SIGNALLING







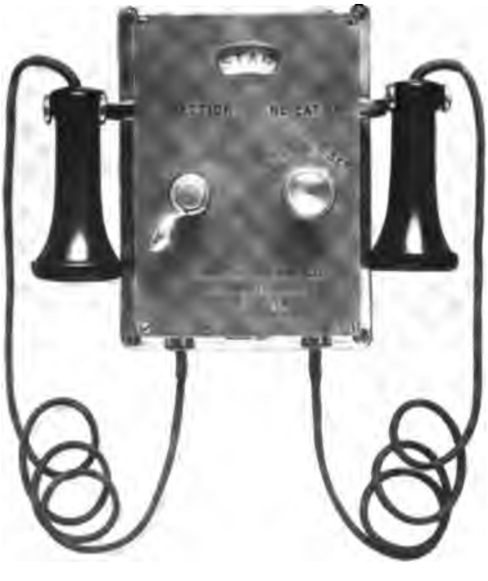


Fig. 2 — Submarine Automatic Bell
Fig. 4 — Oscillator

Fig. 3 — Pneumatic Bell
Fig. 6 — Indicator Box

to operate the vanes of the bell of the type first described above, an electric bell is provided which is operated by electricity generated on shore and carried to the bell by a cable.

Another commercial form of sound-producing device for submarine work is the oscillator shown in Fig. 4, devised by Prof. Reginald A. Fessenden. The Fessenden oscillator is an electro-magnetic mechanism which is capable of producing sound waves in water of very large amplitude and, at the same time, can be controlled with ease. The Fessenden oscillator is shown in Fig. 4. A diagrammatic cross-sectional drawing of the oscillator is shown in Fig. 5.

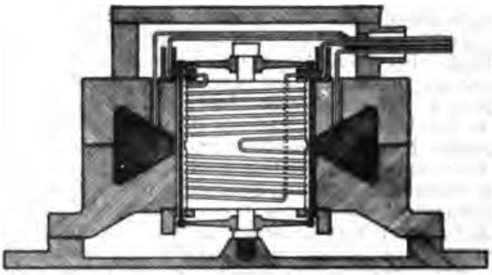


Fig. 5.—Submarine Signaling.

The oscillator consists of a ring-shaped electro-magnet within which is a steel cylinder or core upon which is wound the requisite number of turns of wire. In the air gap between the core and the electro-magnet is a copper tube. The supports of the copper tube are two steel discs, rigidly clamped to a shaft, one end of which is firmly secured to a steel diaphragm, the outer face of which is in contact with the water when the oscillator is in use. The field magnet is energized by a direct current when the oscillator is in operation either for sending or receiving. When used for sending, an alternating current of approximately 540 cycles per second is made to pass through the core winding. This causes currents of electricity to be generated by induction in the copper tube with the result that great forces are produced which cause the tube to move back and forth at the frequency of the alternating current. The motion of the tube is transmitted to the diaphragm and to the water in contact with it. When the oscillator is used for receiving, the core winding is connected to telephone receivers. When incoming sound waves actuate the diaphragm, motion is imparted to the copper tube and currents of electricity are induced into the core winding. The currents in the telephone receivers, connected to the core winding, produce sounds of the same periodicity as those vibrating the diaphragm of the oscillator.

The Fessenden oscillator, when sending, produces a series of waves of constant frequency or pitch so long as an alternating current is passed through its core winding. By applying the alterating current to the oscillator for different lengths of time, it is possible to send series of waves of greater or less duration so that such series will correspond to the dots and dashes used in telegraphic communication.

Direction Finding.— It is customary when submarine signaling devices are used on shipboard to use at least two instruments and to so mount them that sound which reaches one instrument may be screened, under certain conditions, from the other. This is accomplished, in the simplest case, by mounting two small tanks on the ship's plates, inside the ship, one on each side toward the bow. The tanks are filled with water (or other fluid) and the sound-receiving devices are submerged in the water within the tanks. Each sound-receiving device is so arranged that it can be connected by means of a switch, with telephone receivers which can be held at the ears of a listener. When sound waves from a distant source reach a vessel equipped in this way, the sound waves agitate the sides of the vessel, and through the medium of the water in the tanks actuate the sound-receiving devices, thus varying the electric current and so producing similar sounds in telephone receivers. The sounds heard in the telephone receivers will be loudest when they are connected with the receiving device on the side of the vessel nearest to the source of sound. By turning the vessel until the sounds are the same from the receiving devices on both sides of the vessel, the direction of the source of sound can be ascertained, for the reason that when the sounds are equal the vessel must be pointing directly toward the source of sound. The so-called "indicator box," which is customarily employed on ships equipped with microphones supported in two tanks, one on the starboard and the other on the port side of a ship, is shown in Fig. 6. This device provides the means of connecting the telephone receivers with the microphones in either the port or starboard tank as may be desired.

While the above arrangement is that which has been most commonly used in direction finding, other methods are employed with satisfactory results which do not require the ship's course to be changed in order to obtain direction.

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SUBMARINE WARFARE. Of the many new instrumentalities of destruction employed during the recent World War the submarine torpedo boat proved the most effective. It differs from battleships and cruisers in that it operates for the most part beneath the surface of the ocean, it is slower of speed, frail of structure and possesses no facilities for the accommodation of crews and passengers found on the vessels which it sinks. Its inability, therefore, to comply with the well-established rule of international law governing prize destruction, which requires a naval commander before destroying a merchant vessel to provide for the safety of all persons on board, raised the question as to whether such craft were entitled to a special immunity from the rule governing prize destruction by cruisers and battleships, in short whether the submarine may be employed for the destruction of merchant vessels without violating the law of nations as well as the principles of humanity. Soon after the outbreak of the war the German naval forces for the most part were driven from the ocean and compelled to take refuge in their home ports or in those of neutral countries. The Germans were, therefore, reduced to reliance upon submarine torpedo boats in their naval operations against the enemy and these were speedily built in large numbers and used on an extensive scale. By a decree of 4 Feb. 1915 the waters around the British Isles were declared to be a "war zone" within which, it was announced, all enemy merchant vessels would, if possible, be destroyed, notwithstanding the inability of the destroying submarines to provide for the safety of the crews and passengers found in such vessels. In pursuance of this decree scores of enemy merchant ships, including great ocean liners like the *Lusitania*, the *Falaba*, the *Arabic*, the *Persia* and many others, were torpedoed and sunk, sometimes without any warning at all or after warning which was insufficient to permit the persons on board to take to the lifeboats. In consequence of this mode of warfare large numbers of non-combatants, men, women and children, of neutral as well as of enemy nationality, lost their lives. A considerable number of neutral vessels were also sunk, the excuse alleged by Germany in most cases being mistake, which was an inevitable result of a method of naval warfare in which visit and search are never practised. In consequence of the protest of the American government and of its threat to hold the German government to a strict accountability for the loss of American lives, the German government in September 1915, while disclaiming all responsibility for the loss of more than a hundred American lives on the *Lusitania*, gave the American government assurance that in the future "liners would not be sunk without warning and without providing for the safety of the persons on board, unless the vessels attempted to escape or unless they offered resistance." The pledge, however, was not observed and on 5 October, in consequence of the American protest against the torpedoing of the *Arabic*, the German Ambassador informed the Secretary of State that orders had been given submarine commanders which were so stringent that the recurrence of "incidents" like the torpedoing of the *Arabic* would not again be possible. But notwithstanding these assurances, German and Austrian submarines continued to sink merchant vessels, enemy and neutral alike, without warning and without making provision for the safety of the innocent persons on board: among the most flagrant instances being the torpedoing of the Italian liner *Ancona* on 7 Nov. 1915, with the loss of more than 200 lives. It was true that this atrocity was committed by an Austrian submarine but it was understood in the United States that the German pledge bound the allies of Germany equally with herself and the Austrian government was fully aware of the American position in regard to the torpedoing of merchant vessels without making provision for the safety of their crews and passengers, and it was fully cognizant of the pledges given by Germany to refrain from the practice in the future. The action of the submarine commanders in continuing to fire upon the passengers while they were endeavoring to take to the lifeboats was characterized by the American government in a note to Austria as "wanton slaughter of defenceless non-combatants" and a demand was made upon the Austrian government that the officer guilty of the act be punished and that an indemnity be promptly paid for the loss of American lives.

In February 1916 the German government announced that after 1 March its submarines would sink whenever possible and without warning all armed merchantmen, irrespective of whether they were armed for defensive or offensive purposes. The German government took the position that a merchant vessel had no right to carry guns, not even for the purpose of defense. Although the practice of carrying arms for defense against unlawful attacks had been followed by the merchant vessels of all nations for 200 years, the German government maintained that this practice had been introduced for the purpose of enabling them to defend themselves against pirates and later against privateers, but since piracy had disappeared and privateering had been abolished by the Declaration of Paris in 1856 the old rule no longer had any *raison d'être* and consequently the German government could not recognize it as binding. In short, according to the German contention, the rule was never intended to authorize merchant vessels to arm for the purpose of defense against the lawfully commissioned war vessels of belligerents. In fact not only armed merchantmen but also unarmed merchant vessels continued to be sunk, notwithstanding the pledges of September and October 1915. The torpedoing in April 1916 of the *Sussex*, an unarmed English Channel steamer, with 380 passengers on board, some 80 of whom lost their lives, came very near precipitating a crisis in the relations between the United States and Germany. The German government at first denied responsibility for the act, but when the proof produced removed all doubt as to this the German government finally acknowledged that the steamer had been torpedoed by a German submarine.

The President in an address to Congress, on 20 April, reviewed the history of German submarine warfare since its inauguration in July 1915 and informed Congress of the contents of a note which he had two days before dispatched to the German government and in which he denounced German methods of submarine warfare as contrary to both the law of nations and the sacred principles of humanity. The President concluded by saying that unless the "Imperial government should now immediately declare and effect an abandonment of its present methods of submarine warfare against passenger or freight carrying vessels, the government of the United States can have no choice but to sever diplomatic relations with the German Empire altogether." The German government replied that it had "imposed far reaching restraints in the use of the submarine," denied that the torpedoing of the *Sussex* was but one instance of a deliberate policy of indiscriminate destruction of merchant vessels of both enemy and neutral nationality, as the President had charged in his note; declared that it was ready to admit that there had been unavoidable errors and, again for the hundredth time, placed the responsibility upon Great Britain for having proclaimed a blockade against Germany for the purpose of starving the German nation, men, women and children alike, into submission. Notwithstanding all this, however, the German government in "the interest of the sacred principles of humanity" pledged itself that in the future unarmed ocean liners would not be torpedoed without warning provided they did not attempt to escape or offer resistance. This was the third time a pledge of this kind had been made to the American government. Like the others it was not lived up to and a considerable number of unarmed vessels were torpedoed and sunk by German submarines. As time passed, public opinion in Germany demanded a repudiation of the pledges given by the German government and the resumption of the policy of unrestricted submarine warfare. The tightening of the Anglo-French blockade and the growing feeling that this policy alone could save Germany from defeat intensified the popular demand. Finally, on 31 Jan. 1917, the German government threw off the mask and informed the American government that in consequence of a "new situation" having arisen which forced Germany to "new decisions" Germany must resume the liberty of action reserved in the *Sussex* pledge of 4 May 1916, and that, therefore, beginning on 1 Feb. 1917, German submarine commanders would no longer be bound by the previous assurances given to the American government. German submarines would, therefore, sink without warning all merchant vessels, *neutral as well as enemy*, encountered within a vast zone embracing more than a million square miles of the open seas (see WAR ZONES). The "new situation" referred to in the German note was the refusal of the Entente powers "owing to their lust of conquest," to enter into a discussion of peace terms with Germany and their avowed determination to starve the German people into submission in "brutal contempt of international law." The American government, it was added, knew the steps which Germany had taken to cause England and her allies "to return to the rules of international law and to respect the freedom of the seas" and the hope was expressed that it would "view the situation from the lofty heights of impartiality and assist on their part to prevent further misery and unavoidable sacrifice of human life." In consequence of this deliberate repudiation of its pledges the President recalled the American Ambassador from Berlin, handed the German Ambassador his passports (3 Feb. 1917) and broke off diplomatic relations with the German government.

The new policy thus announced by the German government was promptly and ruthlessly put into effect and large numbers of merchant vessels, neutral and belligerent alike, were torpedoed and sunk without warning. Neutral vessels laden with innocent cargoes even when consigned to their own governments, ships homeward bound in ballast, even hospital and Belgian relief ships proceeding on missions of mercy and philanthropy, in fact vessels of every nationality and mission were sunk as if they were pirate vessels. Down to 29 March 1917, 226 American lives had been lost since the outbreak of the war, in consequence of the torpedoing of merchant vessels by German submarines. In August 1917, the American consul, Mr. Frost, at Queenstown placed the total number of British lives, mostly non-combatants, lost in consequence of the German methods of submarine warfare at more than 10,000.

Turning now to a consideration of the lawfulness of this method of naval warfare we may state that a belligerent has an undoubted right to sink the merchant vessels of the enemy with certain exceptions (e.g., coast fishing vessels, hospital ships and vessels on philanthropic missions) in certain cases as where he cannot take the prize in to a home port for adjudication by a prize court, either because of imminent danger of recapture or for lack of a sufficient coal supply or because of his inability to spare a prize crew, and the like. But a long established customary rule of the law of nations requires that in such a case the commander must, before proceeding to the destruction, remove the passengers and crew of the vessel and provide for their safety, that is, he must take them aboard his own vessel or allow them ample time in which to take their own lifeboats. This humane rule is expressly laid down in one of The Hague Conventions, in the Declaration of London, and is even incorporated in article 116 of the German prize code as promulgated in August 1914. It is an equally established rule of the law of nations that the captor must visit and search the vessel, examine its papers and inspect its cargo, in order to satisfy himself of the nationality of the vessel and of its liability to destruction. The verification of these facts obviously cannot be made through the periscope of a submarine at a great distance. The German government frankly admitted that the obligation to provide for the safety of crews and passengers was binding upon the commanders of warships and cruisers but it denied that it was equally binding upon the commanders of submarines, for the reason that they were small craft, slow of speed, fragile in construction and were without facilities for accommodating crews and passengers found on the vessels which they destroy. By reason of their lack of speed it would often be impossible for them to give sufficient time for the crews and passengers to leave the ship and embark in lifeboats, without exposing the submarine to destruction by vessels of the enemy which might upon signal arrive on the scene before the torpedo had done its work. Moreover, it was argued, British merchant vessels were generally armed with guns which might be turned upon the attacking submarine with deadly effect in case it gave warning and an opportunity to the persons on board to leave the ship, before the torpedo was discharged. The rule in respect to providing for the safety of crews and passengers, the Germans argued, originated at a time when submarines had scarcely been dreamed of. Cruisers and battleships then were the principal craft employed for destroying enemy merchant vessels and they possessed facilities for accommodating crews and passengers or they could allow them sufficient time to take to the lifeboats without themselves being exposed to the danger of destruction. To require submarine commanders to observe this rule would in effect render the employment of the submarine for the destruction of prizes impossible, and this being the only available craft left to Germany for carrying on the war at sea she could not be expected to relinquish it. "New situations," said Professor Fleishmann of the University of Königsberg in an article on the "Lusitania Case," "necessitate new rules" and the submarine being a new weapon is not bound to conform to the rules adopted long ago for the conduct of cruiser warfare. «Who,» said Professor Zittelmann of the University of Bonn, «would have thought at the time the old rule regarding provision for the safety of crews and passengers, of the possibilities of submarine warfare.» Had the use of submarines been anticipated, he says, «special rules governing their employment would have been devised» (see his chapter in a book entitled '*Deutschland und der Weltkrieg*,' 1916). The submarine, said Count Bernstorff in a memorandum laid before the Department of State on 8 March 1916, is «a new weapon, the use of which had never been regulated by international law.» From this doubtful premise he drew the unwarranted conclusion that in using this weapon Germany «could not and did not violate any existing rule of law.»

In the main, the German argument reduced itself to a claim of special immunity for submarines because of their peculiar build and consequent weakness. Since it is impossible to employ them in conformity with the long established rules governing prize destruction their commanders are relieved from the obligation to do so. In short, a prohibited method of warfare becomes legitimate whenever a new instrument for doing it is invented — that is, whenever an immediate belligerent interest would be subserved by the employment of an instrument which cannot be employed in conformity with the existing rule of law, the rule may be overridden and the interest allowed to prevail. This argument is specious; it ignores the fundamental fact that the rule of international law which requires naval commanders to spare the lives of innocent non-combatants on the merchant vessels which they destroy was adopted in the interest of humanity and was intended to govern prize destruction by any and all types of vessels which then existed or which might be invented in the future. To argue that a submarine commander may drown unoffending non-combatants but that the commander of a cruiser cannot is preposterous. The employment of new instruments and agencies of destruction must be adjusted to the requirements of the law, not the law to the instrument; it cannot be admitted that the invention of a new weapon may serve to repeal the law of nations and of humanity. The German defense harmonizes well with their theory that «whatever is effective and whatever tends to shorten the war is legitimate»; in its final analysis it amounts to a claim that a single belligerent may at will change the law of the sea to meet his own immediate necessities. The United States Supreme Court in the case of the *Scotia* laid down a principle of international law which has never before been contested that «the law of the sea is universal and cannot be changed by a single nation.» Germany, therefore, had no right to repudiate a long established rule which by common agreement had come to be a part of international law. It will readily be admitted that the introduction of the submarine will necessitate certain modifications of international law, those governing blockade, for example, but it cannot be admitted that the invention of a new instrument of destruction can alter what the President of the United States called «those rules of fairness, reason, justice and humanity which all modern opinion regards as imperative.»

The Germans claim, in fact, that in many instances in which their submarines destroyed merchant vessels they saved the persons on board *whenever possible*. But there are almost no recorded instances in which crews or passengers were taken aboard the submarine, for the good reason that submarines have no accommodations for any but their own crews. The Germans likewise claim that wherever possible they allowed sufficient time for the crews and passengers to leave the ship and take to the life boats, but the instances in which this was not done are so numerous that it may be said that the contrary practice was rather the rule. In many cases where warning was given beforce the torpedo was discharged, the period of time allowed, sometimes not more than 10 minutes, was wholly inadequate, and instances were common in which huge ocean liners sank while the passengers were endeavoring to leave the ship. Incredible as it may seem also, instances are not lacking (e.g., the *Ancona*) in which the crews and passengers were deliberately shelled while taking to the boats. Even when ample time was allowed the passengers to leave the ship it was only a technical compliance with the rule requiring naval commanders to provide for the safety of the persons on board, for they were set adrift in small boats often hundreds of miles from land, sometimes in mid-winter, without food or drinking water and left to drift at sea for days, to suffer the tortures of thirst and hunger, to die of starvation or exposure to cold or to be washed overboard by rough seas and to drown while struggling to save themselves. The German government readily admitted (in a note of 29 Nov. 1915, relative to the sinking of the *Frye*) that this procedure was not a sufficient compliance with the spirit of the rule nor in accord with the assurances which were given the government of the United States that the crews and passengers of ships sunk by German submarines would not be exposed to danger in this fashion.

Few chapters in the history of the Great War reveal German militarism in a worse light than this cruel war against unoffending noncombatants who were in most instances peacefully navigating the seas for the freedom of which the German Government pretended to be fighting. For sheer ruthlessness and barbarity there is nothing comparable to it in any other modern war. German methods of submarine warfare have frequently been characterized as piratical. Technically, of course, their submarines were not pirates, since their commanders bore commissions from a belligerent government, but they might with reason be considered as pirates within the meaning of the old rule which defined pirates as *hostes humani generis*. Naturally few reputable authorities on international law outside Germany have been found to defend such methods of warfare, and even in Germany and Austria they have been denounced as barbarous by many persons, notably by leaders of the Social Democratic party. It is difficult to reconcile the conduct of the German submarine commanders with the utterance of Germany's great diplomat, Marschall von Bieberstein, who at the second Hague Conference said: "The officers of the German Navy, I loudly proclaim it, will always fulfill in the strictest fashion the duties which emanate from the unwritten law of humanity and civilization. As to the sentiments of humanity and civilization, I cannot admit that there is any government or country which is superior in those sentiments to that which I have the honor to represent."

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SUBMARINES: THEIR HISTORY, DEVELOPMENT AND EQUIPMENT.

The aerial flight of the bird and the subaqueous navigation of the fish were always wished-for and dreamed-of activities of human ambition. Science achieved both performances between the years 1900 and 1906, when the actions of the denizens of the air and sea were brought within the practice of mankind by the airplane and submarine. Protracted life and motion within each of the elements has in the last Great War been such a prominent and methodical part of warfare that they are already commonplace to us. But while the performance of the dirigible and heavier-than-air machines has been visible by millions of our populace, the invisibility and secrecy surrounding the submarine has been maintained, few ever seeing the submersible in action and still fewer having been allowed access to her internal economy. A fairly lengthy description of the "secrets" of the submarine should be of peculiar interest to readers.

History.—A Dutchman, Cornelis van Dribel, in 1624 invented a successful submarine rowboat, and King James of England was passenger on one in a subaqueous voyage on the river Thames. Contemporaries describe the vessel as an ordinary large rowboat decked over with stout, well-greased leather. About 1652 Le Son, a Frenchman, built a wooden submarine (known as the "Rotterdam Boat") 72 feet long, 12 feet high, with 8 feet beam. It had sharply tapering ends and sloping sides (for defense against projectiles) and iron-tipped legs for resting on the bed of rivers or bottom of the sea. Midships a paddle-wheel propelled the vessel. In 1747 Symons built a submarine decked rowboat having leather bottles projecting through her bottom; when filled they submerged the boat and by forcing out the water with a lever and fastening the necks the boat rose to the surface. An English mechanic named Day built a boat he could submerge 30 feet, remaining 24 hours under water in it. He tried the same performance with a 50-ton sloop on a bet in Plymouth Harbor, but the boat failed to rise and he was drowned. In 1776 David Bushnell, a native of Connecticut, invented his submarine, or rather submersible, boat *Turtle*, so christened because its sides were shaped like the shell of a turtle. When submerged the head of its single passenger remained above the water in a conning tower while he propelled the boat with a bladed tractor forward. Lead ballast kept her submerged. From the rear-end of this lense-shaped hull projected an arm-steered rudder. Sergt. Ezra Lee operated the craft and when the British fleet entered New York Harbor to capture Manhattan Island Lee tried to attach a mine to one of the men-of-war but failed after repeated attempts, barely escaping capture. In 1797 Robert Fulton tried vainly in Paris to interest the French government in his plans for a submarine even after he had built a model and an appointed commission had given a favorable report; he next appealed to the government of Holland. In 1800, however, First Consul Napoleon advanced 10,000 francs for Fulton to build a submarine, which was launched and christened *Nautilus*. It was constructed of copper plates on iron ribs and fish-shaped, 21 feet 3 inches long, 6 feet 3 inches diameter at the widest part. Stability was gained by a heavy keel, above which were water ballast tanks. It was driven by a two-bladed propeller geared to a hand wheel. A dome formed the conning tower. Horizontal planes guided her downwards. Above the surface a sail unfurled itself fanwise on a hinged mast upon pulling a rope. Fulton and another remained submerged, on the trial, 20 minutes in the Seine, extending the period to six hours' submersion later at Brest, aided by a tank of compressed air. He blew up an old ship by attaching an explosive shell to her bottom to prove the practicability of the offensive craft. Failure, however, to injure the English fleet as a proof caused the French government to refuse further negotiations. Fulton went to England and interested Prime Minister Pitt and he successfully blew up the *Dorothea* with a time bomb attached to her during his submersion; but within a week Nelson at Trafalgar so injured the morale of the French fleet that England's danger from sea attack was gone and Fulton returned to America, where he again failed to gain government recognition of the merits of his submarine. The Confederate torpedo boat *David*, which could not actually submerge but had to keep her funnel and pilot-house above water, attacked and exploded a spar-torpedo against the iron-plate protected hull of the U.S.S. *New Ironsides* in Charleston Harbor, October 1863, but did little damage. The Confederate *Hundley* was a true diving craft with ballast tanks, diving planes and driven by hand power. Each of her five trial trips met with serious accidents and loss of some or all her crew. General Beauregard was still able to get volunteers for another trip and determined this time to make it a practical test against the Northern blockade fleet. On 17 Feb. 1864 the *Hundley* blew up the U.S.S. *Housatonic*, a new corvette of 13 guns, in Charleston Harbor, with a spar-torpedo which struck her and exploded her magazine. But the *Hundley* went down with her victim. And this was the first success of a submarine's action with a warship and the only one till the late World War. The *Stromboli* and *Spuyten Duyvil*, constructed by the United States government, submerged their hulls only, leaving the upper works (conning tower, ventilators, etc.) above the surface. With the invention by Whitehead (1864) of the fish torpedo and automatic propulsion by compressed air, the dangers of self-immolation of the aggressors in torpedo attack disappeared. (See TORPEDO). William Bauer, a Bavarian, now invented a submarine craft but it was refused by the governments. Halstead's *Intelligent Whale* (1864–65), quite similar to the *Nautilus*, was supposed to allow a member of its crew (a diver) to emerge and place a torpedo under a ship; experiment ended in failure. In 1863, Captain Bourgois and M. Brun, Frenchmen, built the steel submarine *Plongeur*, 146 feet long, equipped with an 80 horse-power compressed-air engine; she behaved too unsteadily, submerged deeply and her engines had insufficient capacity. The Frenchman Olivier Riou (1861) failed in his trial of electricity as the motive power; then his compatriot, Admiral Aube (1886), took up the electric idea and built a small experimental vessel, the *Gymnote*, on lines laid down by Dupuy de Lôme, who had recently died; it was 55 feet long and had 564 battery cells developing 55 horse power. Showing good points, the French government built the larger *Gustave Zédé*, on similar lines but advanced principles. She failed in every respect at first, but after years of experiment and alteration became practical. From 1886 to 1901 the French government was so enthusiastic in adopting the submarine as an arm of the fleet that she built 29, all electric driven. M. Goubel, a Frenchman, experimented with two small electric submarines at this time but they were failures. In 1878 the Rev. G. W. Garett, an Englishman, built a submarine which he christened *Resurgam* («I shall Rise»). Advancing in his calculations he built a second with a steam engine. On submersion the smoke-stack was closed with a sliding panel and the furnace was shut up tight and the engine under water was run by steam from the reserve tank of hot water. Thorsten Nordenfeldt, Swedish engineer and inventor of the famous gun bearing his name, took up and improved the Garett system so that his boat ran for 14 miles submerged. He next got patents for his vertical propeller device which drove the craft deep under the surface. After tests (1886) Greece purchased his first craft and he built larger submarines (*Nordenfeldt II* and *Nordenfeldt III*), which Turkey acquired. The first of the latter introduced the novelty of a torpedo-tube in the bow to discharge Whitehead torpedoes. They were shipped to Turkey in parts and one was assembled in Constantinople for tests and acted well on the surface, but under water, with every movement of her crew, she lost her level keel and dived nose down or tail first, whichever part her crew worked. Firing a torpedo she lost her balance badly, but seesawed till her crew got her safely to the surface. As no other crew could be found to take the risk, she rusted in dock and when the British attacked the Dardanelles she could take no part in the defense. The Russian Drzewiecki and the Spaniard Peral invented a foot-driven propeller submarine which proved useless. A strange submarine craft indeed was that projected by the Russian Apostaloff, whose hull was armed with great «threads» forming a gigantic screw by means of which, the hull revolving, this great propeller would, the inventor claimed, cross the Atlantic at 111 knots an hour. His submerged hull was to have a large cabin suspended by davits above the water. John P. Holland, an Irishman, in 1875 built a 16-feet long, two feet diameter, cigar-shaped submarine vessel in New Jersey (*Holland No. 1*), which carried a torpedo that was to be attached to the bottom of the enemy ship and then exploded like the plan of Bushnell with his *Turtle*. The craft was divided into an air-chamber fore and aft and two compartments amidships, in one of the latter of which the operator reclined while working pedals with his feet to turn a propeller in the stern. It enabled Holland to practice navigation beneath the Passaic River and neighboring waters. *Holland No. 2* was launched in 1877 and stuck in the mud. She was furnished with an outer hull for water ballast and was driven by a four horse-power petroleum engine. A few experiments proved to both inventor and spectators that she was a failure and he sunk her after salvaging the engine. He persuaded the Fenian Brotherhood to pay for the construction of two of his submarines with a view to attacking English men-of-war, but they do not appear ever to have shown activity. Holland constructed five more submarines without profit; but in 1893 Congress made an appropriation for constructing an experimental submarine and invited bids. Holland won against his competitors and in 1897 his *Plunger* was launched but had so many evident defects she was never finished. *Holland No. 8* followed and failed, but *Holland No. 9* was built and was the first successful submarine from actual practical viewpoints. She was launched in 1898 and was 53 feet 10 inches long, 10 feet 7 inches deep and porpoise-shape. In 1900 she was placed in commission by the United States navy. Her power was conveyed on the surface by a 50-horse-power gasoline motor and by electric storage batteries when submerged and the combination of the two methods of propulsion was the great Holland achievement. Upon filling her water tanks she sank till flush with the water's surface, then two horizontal rudders steered her to a depth of 28 feet in five seconds. As periscopes had not been perfected, she had to rise and dip like a porpoise to get an air-glimpse and aim. Repeated tests produced such satisfaction with Admiral Dewey and his fellow-officers that the United States government ordered six submarines of this type and in 1901 the British Admiralty ordered five. The race was on and all the navies ordered *Hollands* or paid royalties to the inventor's patent to build larger or improved craft. But the British Admiralty acquired the master patents, making a purchase of all rights for Great Britain, and has built up England's fleet on Holland lines, making, of course, many changes. The next *Holland* submarines were built for seagoing purposes and were constructed for the United States navy, having 122 tons displacement, 160 horse-

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1 U. S. S. Holland
3 U. S. S. Narwhal

2 U. S. S. Moccasin
4 U. S. S. Salmon

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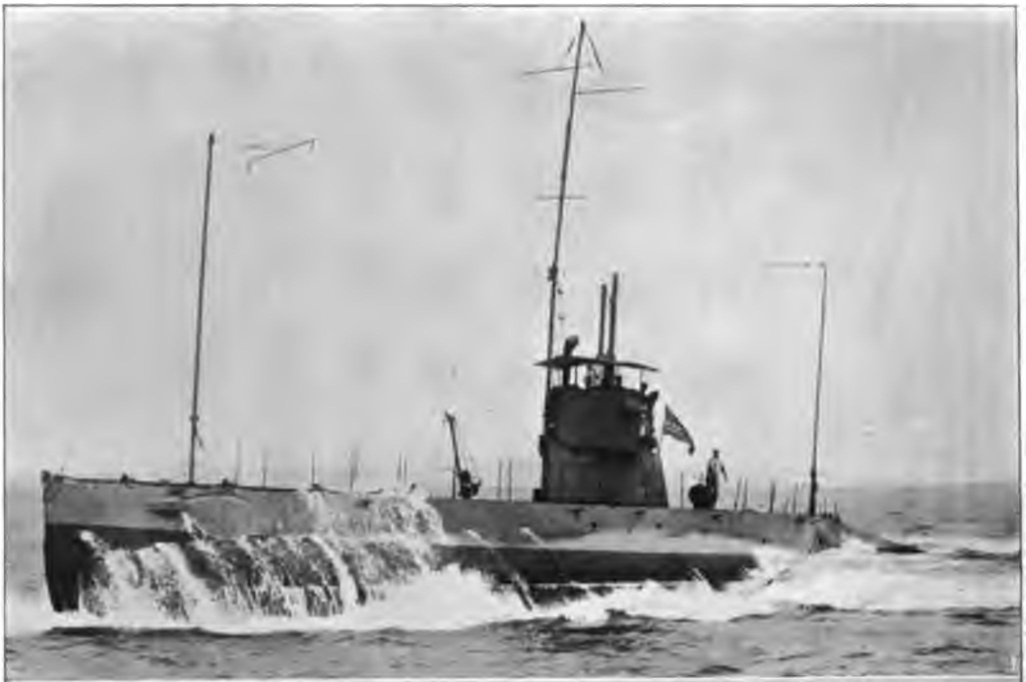

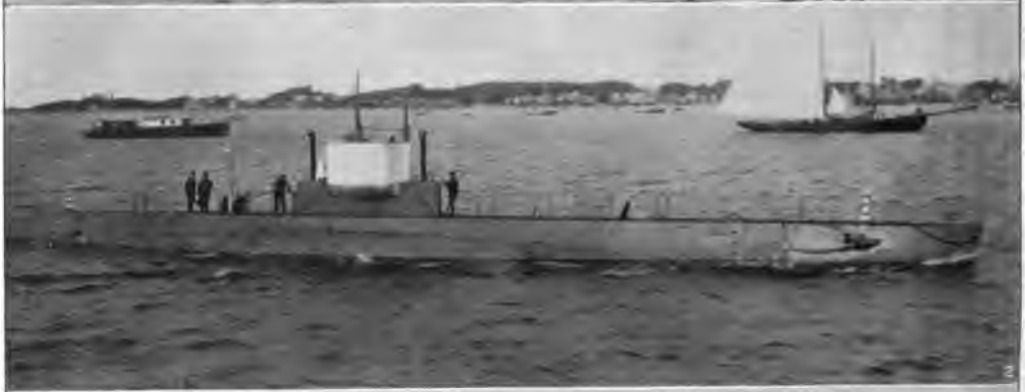

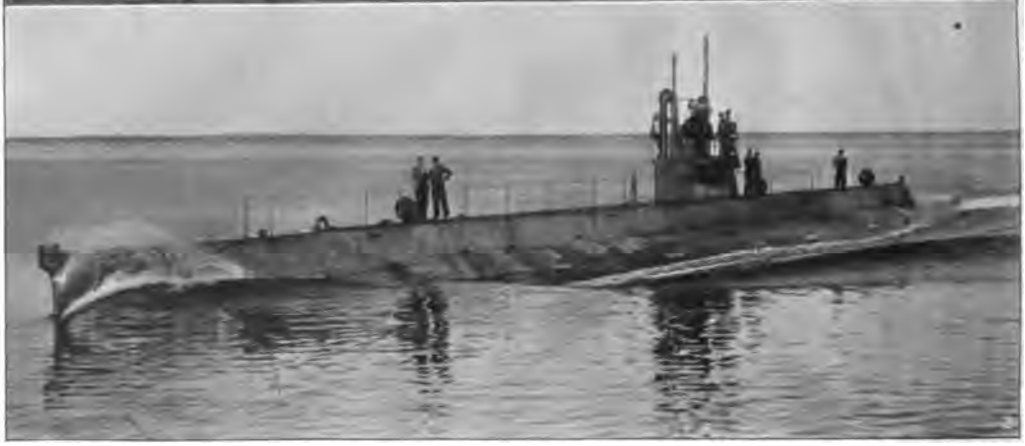

1 U. S. S. K-1 **2 U. S. S. L-4** **3 U. S. S. M-1**

power gasoline engines for surface and 70 horse-power electric for submersion, making, respectively, eight and one-half and seven knots with 300 miles radius awash. These were termed the *Adder* class, after which came the *Viper* class, somewhat larger, and the *Octopus*. The latter was furnished with twin screws and had 273 tons displacement submerged, surface speed 11 knots, produced by internal combustion engine of 500 horse power and 10 knots submerged, developed by electricity. Simon Lake, a Baltimore citizen, built a triangular box-shaped submarine craft, which he named *Argonaut Junior,* that could sink to the bottom of a river or lake and permit a passenger to emerge through the bottom by an air-lock filled with compressed air. The passenger, equipped with a diving suit, could search the bottom of the river. The strange craft was mounted on three wheels, the front pair was rotated by hand gear, the rear one did the steering. In 1897 Lake built his *Argonaut,* having cigar-shaped hull 36 feet long, on similar principles, but with a 30 horse-power gasoline engine, the fresh air being supplied through a hose connected with a float on the water's surface (later changed to two tubular masts). For sinking, *The Argonaut* relied on two anchor weights of over 1,000 pounds attached to cables and raised and lowered by a drum on the vessel. On lowering the weights to the bed of the river, then letting in water to ballast compartments, the weight cables were hauled in till the vessel rested on her wheels at the bottom of the water, when the weights were hauled into pockets in the keel. In 1898, *The Argonaut* traveled from Norfolk to New York under her own power. To fulfil the prophetic vision of Jules Verne's *Nautilus, The Argonaut* covered over 1,000 miles submerged. She was lengthened in New York and a superstructure of ship form was built over her, making her a safe sea-going submarine riding waves easily. *The Narval,* conceived in 1899 by M. Labeuf, was launched in France with its double hull, the outer shell perforated. She used steam on the surface and storage batteries beneath, but absolute silence has been maintained as to advances in French submarines. In 1906, Lake's *Protector* was built and sent to Russia equipped to run along the bottom of the water and cut through enemy nets, avoid mines, rocks and sandbars. Lake was consulted by the German firm of Krupps, who, he says, agreed to employ him as adviser in the building «Lake type» boats and share the profits with him; after parting with his plans and specifications he says the Krupps refused to sign the agreement and used his plans on the submarines they built during the World War.

Until recent years naval authorities divided war submarines into two classes: *Coast defense* type of from 300 to 700 tons surface displacement and *cruising* type of from 800 tons up with radius of 3,000 miles or more.

Submarine Construction and Equipment.—As may be supposed the apparatus and mechanism for such a complex condition of warfare must be very elaborate and complicated. The submarine's internal bewildering labyrinth of pipes, valves, gears, wheels, cylinders, etc., crowding the confined space is the wonder of those few visitors who are allowed an inspection of their interior workings. We will give a short review of the subject as described by such experts as M. F. Hays and others.

Hulls.— Submarines are built with double and single hulls. The latter have to be of considerable strength to resist the pressure when submerging deeply, necessitating a circular or nearly circular cross section. They were of so-called *spindle* shape, both ends tapering to reduce the resistance in motion, but to obtain better sea-going qualities the bow and stern have been modified in recent construction. The Holland type has single and double hulls; the Labeuf type has an inner hull cylindrical with flat ends; this is enclosed entirely in an outer hull pointed at each end to reduce resistance in motion. The latter are used by the French, Austrian and German (Krupp-Germania) navies. Another type has single hull reinforced in parts by an outer construction as employed by the Italian, Portuguese and Brazilian navies and designed by Maj. Cesare Laurenti of the Fabbrica Italiana Automobil Torino (*Fiat*), while the Dutch and Danish navies have used a composite hull designed by M. F. Hay. Other types have, of course, been developed.

Engines.— Steam soon had to give way to high-speed internal combustion engines. The first «Hollands» built for the British navy were fitted with four-cylinder vertical engines. Next came 16-cylinder Wolseley horizontal motors with 550 horse power; later, with increased dimensions they arrived at 850 horse power, giving 16 knots surface speed. The remaining defect was the noxious gas from the petrol or gasoline fuel, sickly as well as dangerously explosive, not to mention carburetor objection so well-known to aviators. Then came the new Diesel motor invention using heavy (crude) oils and all the above troubles were wiped out when the early slow-speed defects were overcome. England used her first Diesel motor on submarine *DI* in 1907, developing 1,200 horse power. Its simplicity of operation, though complicated in mechanism, makes the Diesel engine (see INTERNAL COMBUSTION ENGINE) perfect for surface propulsion, its low cost of running also being much in its favor. A development of 5,000 horse power by 1915 was a great advance over two- and four-cycle engines. The Fiat firm advanced the high-speed Diesel greatly and Britain gradually took up the work; all boats since and including the E and F class have Diesel engines. Diesel engines have been used on all United States Holland boats for the last ten years. The driving power for under-water activity remains electricity, derived from batteries placed below the main floor of the machinery space. On later types of submarines, batteries are placed in a lead-lined compartment to prevent corrosion of hull by sulphuric acid fumes. But in recent types the Diesel engine charges the batteries and does away with these dangers. Krupps of Kiel and M.A.N. of Nuremberg developed, at the German government's expense, engines best adapted for their 900 tons submerged displacement submarines and (1915) two Diesels of about 900 to 950 brake horse power were installed on each and found to act admirably. Many other navies were supplied with them. The M.A.N. Diesels constructed at Augsburg four-cycle, 800 horse power and the Nuremberg M.A.N. two-cycle motors of 900 horse power. The Diesel engines of the British submarines were built by the Vickers company and are four-cycle; those for E class developed 800 horse power in eight cylinders. The Fiat two-cycle 1,300 horse-power motor has been used by both Italian and British submarines, having six cylinders and 400 revolutions per minute. The Sulzer Brothers (Swiss) two-cycle reversible 600 horse power were used at that time (1915) by the United States and Japan. The Polar (Stockholm, Sweden) four-cycle motor was used by the Swedish navy.

Tank System.— The submerging from surface to underwater conditions is brought about by reducing the vessel's buoyancy by means of filling her tanks with seawater. The tanks of the single hull construction are, of course, built inside the vessel, whereas in the case of double hulls the intervening space between the hulls is the tank space. But the disposition and dimensions of these water-ballast tanks is one of the most important problems of submarine building. The safety as well as the efficiency of the vessel hinges entirely on the absolutely correct calculations made in designing the submarine. The history of failures and accidents is generally that of faulty tank distribution. With full tanks the vessel must lie on a level keel under the water. The tankage space has to be divided into a dozen or more compartments so that each unit shall be strictly self-contained in its action and each tank must be *completely* filled before submerging. This set of «main ballast tanks» has to reduce the buoyancy, leaving only 25 per cent. In about the middle of the ship's length is another tank known as the «central,» «midship,» «buoyancy» or «auxiliary» tank; this must *never* be completely filled after submerging. Next come the «trimming» tanks located fore and aft, used in maintaining the vessel on an even keel when getting ready to submerge. All submarines have the above tanks. To them are added, generally, «compensating» tanks, each to compensate for the consumption used up in operating. Thus we have fresh water, the torpedo, the fuel and the lubricating oil compensation tanks; all needed to maintain the original weight. A «safety» tank is installed in some submersibles for use in case of emergency (accidents, etc.); this is quickly emptied by air pressure. But in recent constructions each tank is made capable of being emptied by air pressure, making the special one unnecessary. Emptying the tanks quickly brings the submarine speedily to the surface in case of accident.

Steering Gear.— Steering can be performed on top of the conning tower, in the conning tower or in the «central station,» properly called central operating compartment. Small submarines are steered by hand power, the larger by electricity, but in the latter case, as on other ships, emergency handgear is provided for use in case of electric trouble. An indicator alongside the steering gear shows the rudder's position and direction is found by repeating compass when a gyroscopic master compass is installed, otherwise the steering station has its own compass if magnetic or has an image reflected from the master compass.

Diving Gear.— The diving «hydroplanes» (horizontal rudders) are operated similarly to the rudder. When the diving rudders are at bow and stern there are generally two hand wheels and the operators receive each instruction from the first officer. In sight of operators are depth gauges (the depth attained is read on a pressure diagram) and two indicators display position of rudder and inclination of the vessel respectively. The submarine under ordinary conditions cannot remain below water unless under way, at least slowly, but when it is necessary to stay in one spot for a period there is available the «statical diving gear» which admits and ejects a small amount of water into or from the central ballast tank as the vessel shows inclination to rise or sink from her position.

Air System.— The need of air on board is for many purposes besides breathing. Air is installed in seamless steel flasks compressed 2,500 pounds pressure per square inch and others at 1,000 pounds. After reduction of the pressure by valves the first kind is used for blowing out the water tanks, for charging the torpedoes' air chambers, for charging the flasks for firing the torpedoes, for refreshing the air breathed by the crew and for blowing the whistle; the latter pressure air is required for starting the Diesel engines.

Water Piping System.— Several pumps driven by electricity are generally installed to give a duplicate system of piping to each tank and they are so distributed as to preclude *all* pumps being thrown out of commission in an accident.

Refrigerating System.— This is installed for campaigns in tropical waters.

Heating System.— This is installed for campaigns in frigid waters as the North Sea, north Atlantic, etc.

Anchor Gear.— In great storms on certain occasions anchoring is an urgent need. In spite of the difficulties attending the invention of a practical device in recent years most large submarines are equipped with two located on bow and capable of use while submerged, operated, of course, from the inside, but for fear of inability to disengage the anchor when let down, a method had to be devised to cut the cable or slip it.

Navigating Appliances.— Under submerged conditions a gyroscopic compass set is, of recent years, considered among the necessities. It consists of the master compass in the central station and three repeating compasses magnetically operated by the former and located at the steering stations. A device for depth sounding is also necessary as the submarine often runs in uncharted waters. The engine-room telegraph, speaking tubes, ship-lights, etc., are those common to ordinary ships.

Air Regenerating System.—A few navies supply each submarine compartment with a vessel containing a chemical to absorb carbon-dioxide and several flasks of compressed oxygen for emergencies when the vessel has to stay submerged over 24 hours and the air becomes vitiated.

External Fittings.—All submarines except the Laurenti type carry a walking platform constructed with light metal plates and which also answers as a smooth surfaced covering to the anchor gear, entrance and escape hatches, lifting eyes, engine exhaust pipes and other projections that would afford resistance in navigation. The conning tower, located midships, has been greatly increased in dimensions in recent years to afford space for navigating the

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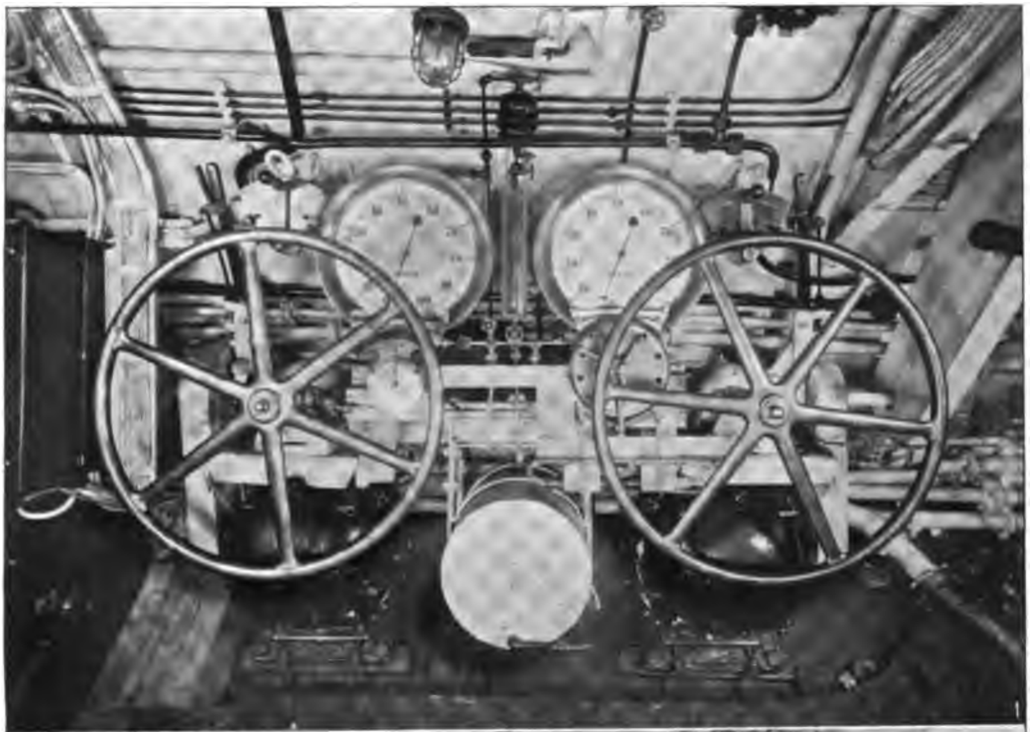
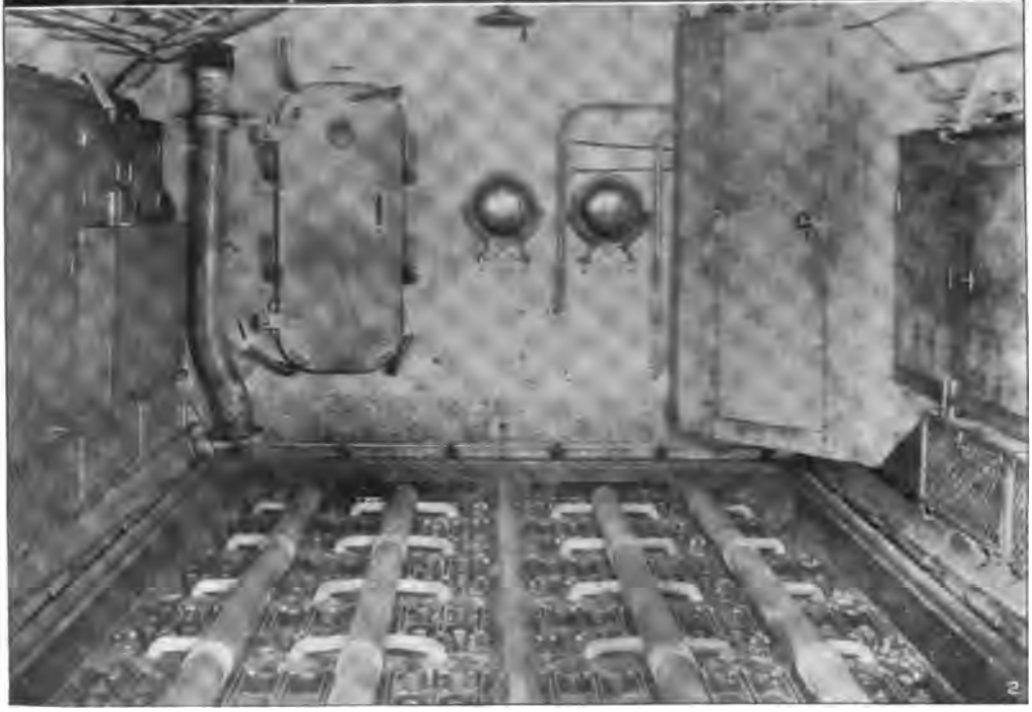
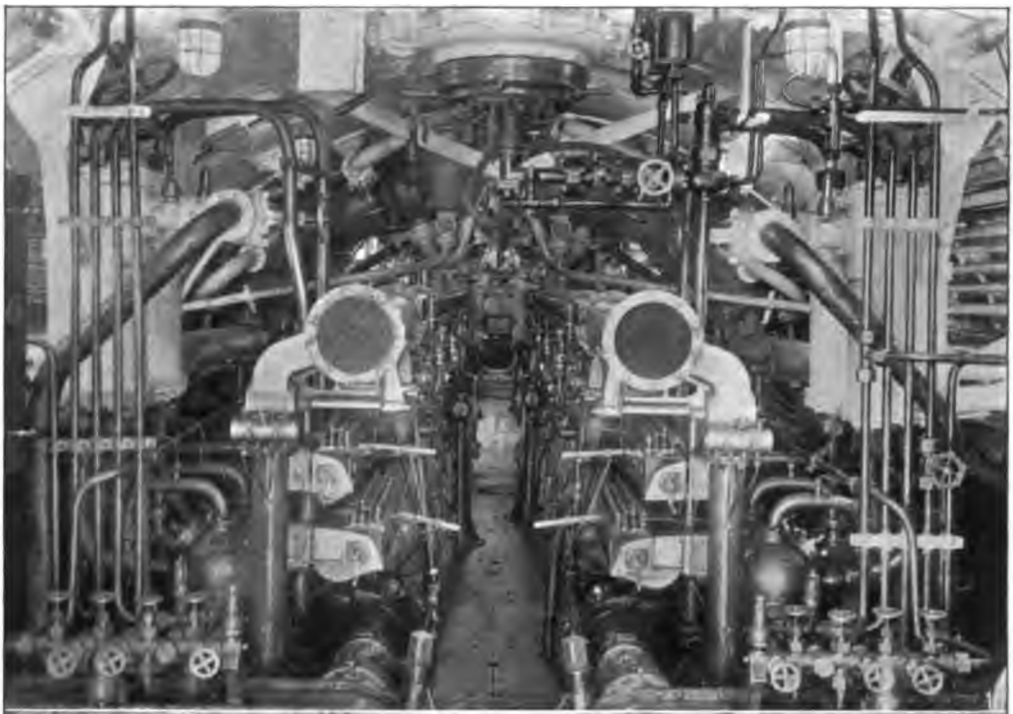
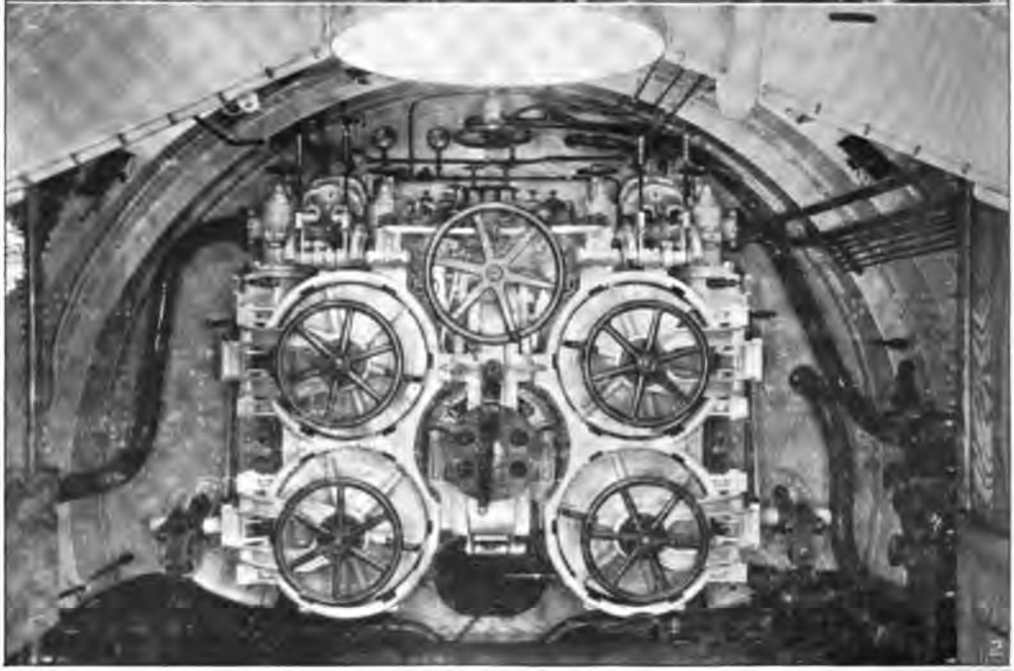


1 View of diving rudder control



2 View of battery compartment





1 View of engine room

2 View of torpedo tubes

vessel on the surface when stormy weather forbids using the bridge. Some of the German conning towers reach nine feet above the upper deck. In the German boats one of the periscopes enters the conning tower and navigation in such is carried on in the conning tower when slightly submerged and, therefore, has to be sufficiently roomy to hold two or three men. In the walls of the conning tower are eight or so sighting ports fitted with plate glass about an inch thick to resist the great pressure; bronze port covers are also provided to aid in withstanding the pressure when very deeply submerged or when the glass gets broken. A portable railing is provided for use around the superstructure deck and is removed on submerging. Exposed to view outside the hull are a towing hook for use when disabled and abaft the forward bow are the diving rudders, some of which fold up into a pocket leaving the space occupied flush and as they are only in use when submerged they are operated from inside the hull. On the deck is the bell for signaling under water. (See SUBMARINE SIGNALING). The perpendicular pipes that project from the wave-breaker are ventilators communicating with the living quarters and engines. Large submarines lately carry a folding-boat that is stowed in the superstructure.

Living Arrangements.— On the larger or sea-going boats the average of three officers and 20 men have three separate cabins fitted up rather similarly to the quarters on a steamship, with plenty of locker accommodation and steam-heated in cold weather. Steel work is encased in compressed cork to absorb moisture. The cook's galley is equipped with electric range, oven and hot-water reservoir. Coffee and soup are kept heated electrically in urns.

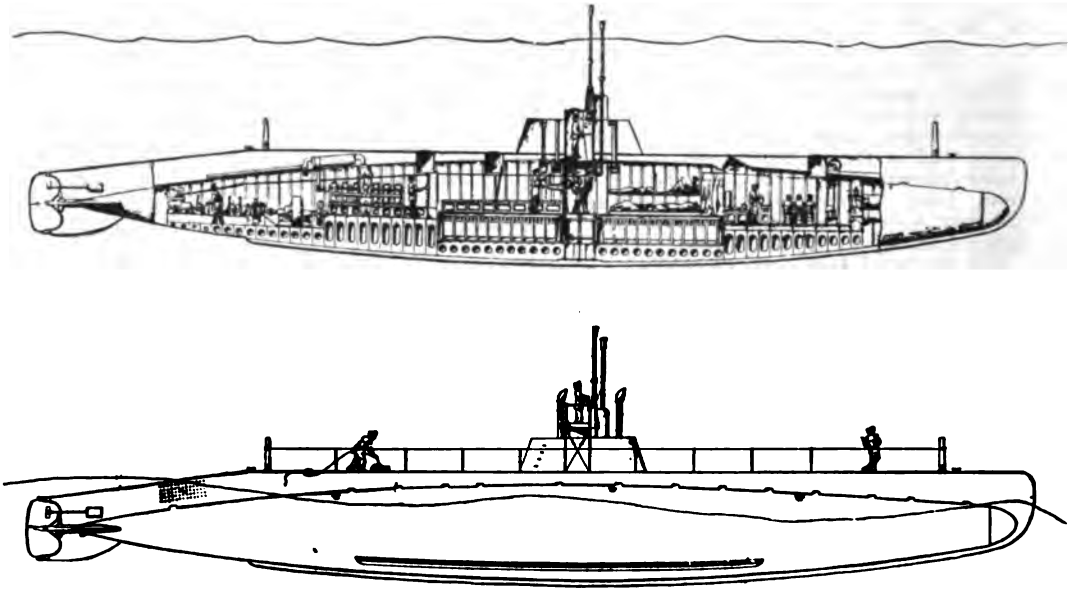
Armament.— Most navies equip their submarines with four torpedo tubes, two on the bow and two astern; others carry an additional two in the superstructure; the latter are of fixed or revolving type. Some British submarines have fixed port and starboard broadside tubes in the interior of the boat. The number of torpedoes carried varies from two per tube to whatever the larger space of the big vessels permit. Both ends of the torpedo tube are covered by watertight caps or shutters each opened and closed by hand. To load a tube the inside cap is opened, leaving the outside closed and the projectile is placed in the tube, the inside cover being at once closed and the open spaces at head and tail of the cigar-shaped torpedo is filled with water by pumping or blowing water from an internal tank specially fitted for the purpose. Next the outer shutter is opened and the projectile is discharged by compressed air, released from a tank and entering behind the torpedo by electric gear operating a large valve. The boat's commander generally performs this latter operation. During the torpedo's egress mechanism in the tube pulls a lever that starts the propelling machinery of the torpedo as it leaves the tube on its deadly mission. Another weapon of the submarine is its one or two three-inch rapid-fire guns used as defense against airplanes, dirigibles and small craft. In submerging the gun is housed in the superstructure aided by its hinged mount. To render the mount more rigid the later German submarines have eliminated the hinge and on submersion leave the gun projecting, after removing the breach-block and sighting telescope. To reduce propulsion resistance when submerged the gun is enclosed in a "breakdown" casing of sheet metal. During the World War cannon have been added to armament, the calibre growing ever with the capacity of the enlarged boat. (See notice, end of article, on the very latest structures).

Periscopes and Range Finding.— The eyes of the submerged craft — the periscope — in its more recently developed form consists of an arrangement of prisms within a vertical tube (see PERISCOPE) adjusted to an eye-piece similar to a marine telescope. Usually submarines have at least two periscopes to provide for loss, besides permitting commander and the steersman to be using one each simultaneously. The periscope tube has about six inches diameter and 18 to 20 feet length above the superstructure. The more recently constructed periscopes have on the upper end a reduced diameter of from two to three inches for the length of five or six feet. This has the effect of reducing the "periscope wave" left in its wake which makes itself more visible to the enemy than the projecting tube. The remaining instrument needful to correctly aiming the torpedo is a range-finding device; for this purpose there are several inventions, space for the description of which in this article is lacking. The dangers attendant on the operation of the submarine have given rise to numerous inventions for their prevention and cure. One of the most interesting is the "safety keel" used in European navies; it consists of a flat, hollow keel filled with lead and has a depth of about 12 inches and about 24 inches width. This is fastened to the hull in such a way as to permit quick releasing in emergency and the reduced tonnage quickly brings the vessel to the surface.

A good example of strictly recent submarine construction is the Holland type, United States submarine *Schley*, built in 1917. It is 263 feet long, displaces 1,453 tons submerged, has surface speed of 20 knots, submerged speed 11½ knots. The hull is divided longitudinally into nine watertight compartments. There are four torpedo tubes in the bow, two port and two starboard; water-ballast tanks are also located here for their discharge. There are also two deck torpedo tubes besides those (four) in the bow. Aft of this is the torpedo compartment. The officers' compartment comes next and the crew's quarters, with storage batteries below deck, is aft of the officers' quarters. Next comes a smaller compartment, the upper part of which contains the wireless operator's room, while the lower half is devoted to cold storage. Next, at about midlength of the vessel comes the central operating compartment with conning tower and the bridge above. The *Schley* has three periscopes, two running into the operating room, the third leading to the conning tower. To the rear of this is another crew's quarters and storage batteries beneath its floor. Next comes the engine-room with its two 12-cylinder engines, capable of driving the vessel at 20 knots on the surface. The next compartment contains the electric motors, one attached to each shaft, together with other auxiliary machinery. Water ballast fills the last compartment. The torpedo armament consists of four fixed tubes in the bow; and two others on a revolvable mount, which are carried above the main hull, and within the false superstructure.

During the progress of the World War wonderful stories appeared in print of the great advances being made by Germany in submarine construction and the immense size of her latest craft. The British navy had been well posted because of steady capture of enemy submarines and their consequent examination. But the officers were silent and the public was unenlightened. Captain Persius, Germany's naval critic, gave out the following figures concerning the German submarine fleet: In 1917 Germany built 83 and had 66 destroyed; in April of that year she had 126 submarines; in October 146. In February 1918 she had 136 and in June 113. England's 1917 War Cabinet declared the German submarine had a surface speed of 18 and 10 or 11 knots submerged. It carried 15 to 20 torpedoes and was able to travel 100 miles submerged, remaining completely submerged up to 48 hours. On fairly reliable information we learn that England at the outbreak of war had about 80 submarines, built about 130 more and lost about 50 during the conflict. The British experts were surprised, when the Germans brought in their submarines according to the terms of the armistice, how little they had to learn from them. By 1917 both England and the United States were building submarines of 1,500 to 2,000 tons. And now, it is claimed, Britain has in her *M-1* a 1,700-ton submarine carrying a 12-inch gun (six-inch guns were the big calibre during the war). She has two tubes and an anti-aircraft gun. It is also said that the British have steam-driven 2,700-ton submarines with surface speed of 23 to 25 knots. In September 1916 was published an interesting report of the United States navy making comparative tests of American submarines alongside the German (examples of which arrived here later). All details are not given out but we read of four of these enemy boats: "The best of these were 'tuned up' for special trial" and a special trial board appointed. The German boat tried was *U-III*, built at Germania Yard, Kiel, 1918, and *S-3*, a submarine designed by the United States Navy Department and commissioned in 1918. They both belong to the 800-ton class with the following measurements:

	U-III.	*S-3.*
Length	235 feet	231 feet
Beam	21 feet	21.5 feet
Draft	12.5 feet	12.5 feet



Longitudinal Section of Submarine.

The report reads: "In the trials the maximum surface speed of the *U-III* was 13.8 knots, while the *S-3* made 14.7 knots. The submerged speed of *U-III* was 7.8 knots, while *S-3* made 12.4 — a remarkable difference in favor of *S-3*. The radius of action of the two boats is also in favor of *S-3*, despite all the furore that was created by the advent of the U-boats on the American coast during the war. *U-III* can cruise 8,500 miles at eight knots, while *S-3* can cover 10,000 miles at 11 knots. The submerged cruising radius shows an equal preponderance in favor of *S-3*. Both can carry 12 torpedoes. *U-III* mounts two four-inch guns, one forward, one aft, while *S-3* mounts one gun forward, this practice of one gun on a submarine being standard practice in the United States navy." Living accommodations are far inferior on the German boat, and, according to the report, unnecessarily so. As to seaworthiness the American is the better, "decks drier, her bridge less subject to green seas, and her general behavior in a sea-way superior." Diving capabilities differed little, but slightly in favor of the *S-3*. The latest word in United States undersea boat construction is the *AA-2* built September 1919 from designs of the Electric Boat Company and declared to be the fastest Diesel-engined boat afloat. She has a cruising radius of about 7,000 miles, is 268 feet long and her surface speed is expected to develop 20 knots an hour, 13 knots submerged.

Bibliography.— Bishop, F., 'The Story of the Submarine' (New York 1916); Hay, M. F., 'Secrets of the Submarine' (New York 1917); Lake, Simon, 'The Submarine in War and Peace' (Philadelphia 1918); Newbolt, Sir Henry, 'Submarines and Anti-Submarines' (New York 1919); Talbot, 'Submarines: their Mechanism and Operation' (London 1915).

SUBPŒNA, sŭb- or sŭ-pē'na, *in law,* a writ directed to a witness, commanding him to appear at the court to testify what he knows in the case therein described, pending in the court. Should the court wish to examine any books or papers connected with the case in possession of the witness, a clause is inserted in the writ instructing him to bring them with him. An action of damages lies against the party disobeying this writ, unless he has a good legal excuse; but the subpœna must have been served a sufficient time beforehand to enable him to arrange his affairs. See WITNESS.

SUBSCRIPTION. From the Latin *sub,* under, and *scribo,* I write. In the common vernacular this term defines the placing of a signature to any written or printed statement. In the law it applies to the signing of one's name to an engagement, or is the attestation of a witness by so writing his name; the illiterate or blind person, however, is permitted to make his mark as a sufficient subscription. It most commonly applies to a person making an agreement over his signature to furnish certain moneys for a particular purpose, as a subscription for a book, or to a charitable institution, etc. The extent to which subscriptions, made voluntarily, for charitable objects are binding still remains a legal problem. In subscribing, "agreeably to the statute and by-laws of a chartered company," the party acquires a right to his shares, which is sufficient consideration to make the subscription binding on his part. Subscriptions to a contemplated corporation may be enforced when the corporation is formed. "The consideration which supports the promise of a subscriber to an enterprise is expenditure by the promisee on the faith of the subscription and not advantage to be gained by the promisor" (41 Ill. App. 259; 57 Iowa 307; 69 id. 134). But "until liability has been incurred or acts have been done on the strength of the subscription, it may be withdrawn, and it is revoked by the insanity or death of the inscriber" (96 Ill. 177; 93 id. 475; 77 Pa. 328). The payment by a subscriber of a part of his subscription, which is not legally enforceable, does not make the residue of said subscription valid.

SUBSEQUENT STREAMS. As consequent streams (q.v.) deepen and widen their valleys, new slopes are formed, no longer toward the ocean, but toward the consequent streams. On these new slopes new streams are developed as tributaries to the older rivers. Their courses are not determined by the original but by the subsequent slope of the land, in part influenced by the softer rocks along the sides of the original valleys. These are called subsequent streams.

SUBSIDIES. From the Latin *subsidium,* support, assistance, composed of *sub,* under, and *sedeo,* I sit. The term subsidies is applied more generally to English law, and the systems in use in this country are brought under the title *bounties.* Subsidies were grants by Parliament of assistance to the king, as taxes or tribute assessed for urgent occasions and levied on all subjects according to their holdings in lands or goods. Later the term applied to aid given by the government to commercial enterprise likely to prove of public benefit. In international law the term applies to money given by one nation to another as an aid to carrying on war without taking active part in such campaign. See BOUNTIES.

SUBSTANCE. Ever since Thales explained the universe in terms of water, there has been an almost irresistible tendency among philosophers to explain the unity of intricate assemblages of phenomena in terms of a permanent quasi-material substratum, or, as it is technically known, a substance. The notion of substance runs through the entire pre-Socratic philosophy, and the Platonic realistic hypostasis of the ideas makes of them something very like the substance of the particulars which they embrace. Substance first receives its name and its separation from form in the philosophy of Aristotle, but this separation is by no means complete. Substance, or τὸ ὑποκείμενονμν, is for Aristotle at once something like the explanatory principles of Thales and the other pre-Socratics, and a form or essence endowed with actual existence. Into the form or essence of a particular not all its attributes enter, but Aristotle never makes clear the principle in accordance with which the essential may be separated from the inessential.

The scholastic view of substance is a perpetuation of that of Aristotle. The essence-aspect of substance was transmitted by the Scholastics to the earlier modern philosophers of the Continent; though the latter progressively emphasized the function of substance as a substratum. Descartes makes mind and matter his two substances, and defines substance as that which depends for its existence on God alone. God is clearly the ultimate Cartesian substance. This view is modified by Spinoza, though more in terminology than in fact; he holds that God is the one substance, and that mind and matter are two among His infinite number of attributes. Whether God is simply the sum of his attributes is left uncertain. The Leibnizian concept of substance is not widely different from that of Descartes, but the number of different substances — the monads — is multiplied indefinitely.

The British philosophers from the start mixed less of the Aristotelian notion of form and essence with their substratum-substance than their colleagues on the Continent. Locke followed Descartes in his dualism, but saw that a substratum which is nothing more than a substratum can only manifest itself through its appearances, and is unknowable in its inner essence. Once this became clear, it was obvious that we might remove the substance from the assemblage of appearances overlying it without making any noticeable difference. But of two indistinguishable situations it is impossible to assert categorically that one exists and the other does not. Berkeley accordingly discarded substance from the realm of matter; he believed, however, that a substantial subject was necessary for cognition. Hume followed Berkeley in reducing the material world to its phenomena, but saw that the notion of substance furnished as little support for the states of a mind as for the qualities of a material object. Combining this with his unwillingness to admit the existence of anything of the nature of a general idea or universal, he was necessarily driven to the opinion that things are mere aggregates of their appearances, which are associated together in a manner quite independent of any inherent relatedness on their part.

The Humian refutation of substance is essentially valid. The very least which we can demand of a principle of explanation is that it should explain; and the explanation of a group of facts is essentially the more intimate correlation of them with the rest of our knowledge. After we have been told that the attributes, say, of the material world are unified through their inherence in a material substance, we know just as little of their bearing on one another and on our remaining stock of information as before. Nevertheless, Hume went too far in denying to the mental and material aggregates of phenomena, respectively, all unity other than that which is furnished by the power of ideas to attract associates. Such collections of entities as the material world, the world of mind, individual minds, etc., have, *prima facie*, a very real unity — the unity, namely, that consists in their forming systems. (It may be shown by such means as are used in the article on UNIVERSALS that this unity is not purely illusory). In the post-Humian philosophies, some such notion of system tends to replace the older concept of substance.

In the philosophy of Kant the system-notion of the unity of phenomena and the substratum-notion are both found, and are almost inextricably interwoven. Kant retains the old, unknowable substances of Hume under the name of the Things-in-Themselves. While he regards the existence of these as indubitable, he nevertheless excludes them from any active part in his critical philosophy, in so far as this concerns itself with the pure reason. Within the realm of phenomena, the substances are just such relational, structural complexes as have been described in the last paragraph. Indeed, substance is made a category of relation. The followers of Kant retained this latter phase of his views on substance, and discarded his things — in themselves. They made the entire universe their ultimate reality but though they generally viewed this in the light of a system, there was not wanting among them the tendency to revert to the substratum idea. However, substance, except as the Absolute may be substantial, was not assigned a fundamental status. Thus in the philosophy of Hegel, substance is but a stage of the cosmic dialectic, not its termination.

Though the problem of substance, under its own name, has ceased to play any great part in current philosophical disputes, there are not wanting in the system of the present day entities which differ from substances in little but their appellation. Certainly the Bergsonian *élan vital* serves as a principle of explanation simply by virtue of being a substratum. There is not a little resemblance between the sense-data and other particulars of modern atomic realism, which serve primarily as pegs on which to hang relations and qualities, and the substances which subserve a like function in the philosophy of Locke. See MATTER; SOUL.

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SUBSTITUTIONS, Groups of. See GROUPS, THEORY OF.

SUBWAYS. Underground railways, now common in cities, have come to bear this name. Of all the difficult problems that have arisen as a result of the great and continuous concentration of population in cities, the most difficult and the most expensive to be satisfactorily solved is the furnishing of suitable and economical means of local travel. With the enormous vehicular traffic that congests the streets, the surface cannot be used except for lines whose speed, being limited by the ordinary street conditions, is too slow, except for short distance journeys. In some American cities, and in a few exceptional cases in European, elevated railroads have been constructed to furnish means of travel on which traffic, freed from surface conditions, could move more rapidly. Such railroads, although successful in themselves, are so unsightly and so objectionable to the abutting houses that they are disliked.

With the surface impossible for use for rapid transit purposes, and with the super-surface undesirable for such use, recourse is necessarily had to the sub-surface, and it is in the development of sub-surface lines that there is the greatest activity. To this class of railroads, and regardless of the method of construction, whether by tunnel or by open excavation, the generic term of Subway has come to be applied. This name is now used to describe a railroad built beneath the surface, with stations at comparatively short distances apart, and primarily intended to serve the needs of local transit in a thickly populated locality.

History.— The first city in the world to feel the need of subways was London, where, in 1853, there was begun the construction of a two-track underground road from Edgeware to Kings Cross. From this beginning there were finally produced two lines, known as the Metropolitan Railway and the Metropolitan District Railway, the greater part of whose construction was finished prior to 1870. These roads were not given a satisfactory location, a compromise route having been determined on by which it was attempted to serve as many districts as possible, the result being that the line lacked directness. This error in proper route selection, and the fact that the railways were necessarily operated by steam locomotives — the only means then at hand — rendering them exceedingly disagreeable for passengers, failed to produce satisfactory financial results, and, consequently, to furnish any encouragement for an early repetition of a similar experiment in London, or, even less so, in other cities, where the demand for transit facilities was less strong. It was not until 1886 that any further attempt was made to construct a subway line; in that year the late J. H. Greathead, an eminent English engineer, designed a railroad circular in section, lined with cast iron, which it was at first intended to operate with a cable, such method of operation having proved successful in America for surface lines, avoiding the disagreeable consequences of operation by steam locomotives. Before the line was completed it had been demonstrated that such railroads could be successfully operated by electricity, and so that power, instead of cable, was installed.

This tubular railroad, the first to be practically operated, the prototype of many others, having conclusively shown that by means of electricity subways could be operated not only free from the objections of steam operated lines, and free from the objections to the construction of elevated lines, but also more economically than by steam, a serious study of the problem was at once taken up in New York, Boston, Paris, Berlin and Budapest. The last-named city has the honor of having produced a new type of subway, which has influenced the most approved form of construction. This road was built with a flat roof, consisting of steel beams with arches turned between them, permitting the whole structure to be brought close to the surface of the street, and was, therefore, in direct opposition to the Greathead method, in which the railroad was carried at a great depth below the surface of the street, necessitating mechanical means of taking the passengers from platform to street level. This line in Budapest was put in successful operation in 1893. In the meanwhile similar lines had been projected both in New York and in Boston, but owing to certain legal delays in the former city work was first begun in Boston. The latter subway was intended for the accommodation of the surface trolley cars in order to carry them through the congested centre of Boston, where, on account of the narrowness of the streets, the speed of the cars had been necessarily reduced to a rate that was intolerable.

The first subway planned in Boston was partly a two-track structure and partly a four-track structure, and had a length of 1.7 miles. This has since been increased and the subway has also been connected with the elevated railroad system, so that at present both the elevated trains and trolley cars pass through it.

When these various railways were put under construction or in operation, the era of subway construction may be said to have become firmly established, and other lines were undertaken in Glasgow and Berlin, some of the shallow type and some of the tubular type, and elaborate and complex studies were being prepared for both Paris and New York. Although the work of beginning subway construction in these two last-named cities had been retarded for one cause or another, the delay has nevertheless worked to their advantage, as the experience gained at other points had proved of great benefit. These two systems now present the most advanced and the highest development in the art of subway construction.

Work on the first line was begun in Paris in 1898. The French engineers, instead of doing as had been done elsewhere — laying out short and detached lines to serve the most urgent requirements and without regard as to the definite part that such lines would play in the final plan of urban development — laid out, at the beginning, a comprehensive map of a great system covering the whole of Paris, embracing all the lines that could reasonably be foreseen as necessary or desirable. This plan covers 47 miles of railway, all of which are considered as a unified system to be operated as a whole, and the construction of which has been steadily proceeding.

The work of building the subway in New York did not begin until the year 1900. In no city in the world are the demands for transit facilities as great as in New York. On account of the peculiar shape of the city the main travel is necessarily concentrated on a few well-established north and south lines, and although great as is the carrying capacity of the elevated and surface systems, such capacity is much inferior to the demands of the population. At the time the first subways were opened the number of paying passengers on the street railroads of New York exceeded 1,000,000,000 per annum. It was decided to build a subway railroad with four instead of two tracks. Of these four tracks, two are used for express trains — that is, trains that stop at intervals of about one and one-half miles — and two of the tracks used for local trains, which stop at intervals of about one-quarter of a mile, in order to differentiate between the passenger who desires to travel a long distance and the one who desires to go a short one.

The initial subway had a length of 20.8 miles, of which 6.3 miles are of four-track, 6.7 miles of three-track and 7.8 miles of two-track. This road begins at a point in front of the City Hall, extends northerly to Kingsbridge in the northwestern part of the city, and to the Zoological Gardens in Bronx Park in the northeastern part of the city, being in plan like the letter Y.

When this work was about half completed, a second subway was designed and contracted for to extend the above railroad southerly along Broadway from the City Hall and under the East River to a point in the Borough of Brooklyn. This extension consists of 2.8 miles of two-track and 0.7 mile of three-track, making in all 24.3 miles in length, with 86.6 miles of track, exclusive of side tracks. Soon after this first subway was in full operation from Atlantic and Flatbush Avenue Station in Brooklyn to Van Cortlandt Park on the west side and to Bronx Park on the east it was seen that additional transportation facilities would be required within a very few years. Negotiations to this end were initiated by the New York Public Service Commission with the Brooklyn Rapid Transit and the Interborough Rapid Transit in 1911 and on 19 March 1913 the so-called dual contracts were signed by these companies on the one hand and the City of New York on the other. Under these contracts the cost of construction was to be borne partly by the city and partly by the operating companies. The latter agreed also to extend their elevated roads and to increase the facilities of existing roads, by third tracking or by constructing a second story structure. The contracts called for the construction of 44.55 miles of new subways; 53.10 miles of new elevated railways, and 19.8 miles of third-tracking or other additional track. The new lines, now practically completed, consist of 330 miles of single track, made up of 260 miles of subway, 45 miles of elevated and 25 miles of new third track, taken in connection with the old lines with their 330 miles of track, constitute a mileage exceeding that of all the other rapid transit systems of the world. The year 1918 saw a number of the new lines included in the Dual System placed in operation, leaving to be finished those lines providing new routes between Brooklyn and Queens and Manhattan by tunnels underneath the East River. These tunnels are difficult engineering feats and require a longer time than does ordinary subway or elevated railroad construction. Subsequent to the completion of the first subway the city determined to build certain additional lines, including the so-called tri-borough route in Manhattan and the Bronx; the Centre Street Loop in Manhattan and the Fourth Avenue Subway in Brooklyn. All these lines later were included in the Dual System. Of the Dual System subway lines, there were opened previous to 1918, exclusive of the first or old subway, the Queensboro Subway; the Fourth Avenue Subway in Brooklyn; its 86th street extension; its Sea Beach branch to Coney Island; its New Utrecht avenue branch; the Astoria branch of the Queensboro Subway; the White Plains Road extension of the first subway; the Corona branch of the Queensboro Subway; the Jerome avenue branch of the Lexington Avenue Subway; a portion of the Seventh Avenue Subway; the West Farms Subway connection, and the Broadway Subway, Manhattan. About 170 track miles of new lines were in operation at the beginning of 1918. On 1 July 1918 the new Seventh Avenue Subway was placed in partial operation from 33d street to South Ferry, and on 17 July the new Lexington Avenue Subway was placed in use from 42d street to 167th street in the Bronx. On 1 Aug. 1918 the so-called H system was tried. The beginning of this system terminated the service of the old subway as it had been given for 14 years. Under the H system the old subway from Times square north with its branches was joined to the new Seventh Avenue Subway, thus constituting the west side subway, while the part of the old system south from 42d street and Fourth avenue was joined to the new Lexington avenue line and its Bronx branches, making a complete through line all on the east side from South Ferry to 167th street in the Bronx. This division of the old subway left the part under 42d street from Grand Central Station to Times square as cross-bar to the «H.» Its tracks were assigned as follows: Two tracks for a shuttle service between the east side and west side lines, and two tracks for a continuation of the Queensboro Subway west from Grand Central to Times square. Very serious delays in the work of construction of the new lines occurred in 1917–18, owing to the fact that the demands caused by war conditions had been such as to delay the work, and in some respects to bring it to a halt. More subaqueous tunnel work is under construction for Dual System lines than has ever been attempted before. This work represents an expenditure of about $30,000,000, and includes four new tunnels of two tubes each and one tunnel of four tubes. The last named connects the Lexington avenue line in Manhattan with its Bronx branch. The other tunnels mentioned are the 60th street tunnel connecting the 59th Street Subway with the Queens line, the tunnel for the 14th street eastern line, the new Interborough tunnel between Manhattan and Brooklyn and the tunnel connection between the Broadway Subway in Manhattan and the Fourth Avenue Subway in Brooklyn.

The total cost of New York's Dual Subway System, including equipment, real estate, powerhouse construction and changes, interest during construction, etc., will be about $400,000,000. Of this sum about $60,000,000 is contributed by the Brooklyn Company, about $146,000,000 by the Interborough, and the remainder, approximately $194,000,000, by the City of New York.

The general type of subway adopted for New York was of the flat roof shallow form, bringing the rail and platform level as close to the surface of the street as possible. The irregular topography of the city, however, has compelled a departure from this type in several instances, so that a portion of the road is in ordinary deep tunnel, and the portion beneath the East River, and the approaches thereto, is of the tubular type, as adopted in London.

While this work of subway construction had been going on in other cities, London had made many additions to its subway construction by building detached and separately operated lines on the tubular principle, there having been a decided popular prejudice against any form of construction that would threaten to interfere with surface travel during construction, or that would invade the vested rights of the several local governments, which form the constituent parts of the government of the Metropolitan district, or what is commonly known as London.

Construction.— The construction of subways presents a wide field for the display of engineering skill and ingenuity, as a modern line demands the application of nearly all the principles on which engineering science is based. At the time when the first railroad was built in London, iron was expensive, and steel, as a material of construction, unknown, and recourse was had to masonry, except in cases where the use of iron girders was obligatory. The structure was, therefore, a continuous archway, and calls for no extended description.

When the City and South London Railway was begun, cast iron was sufficiently cheap to be used. At that time the building of a line so near the surface as to disturb it, even temporarily, was out of the question, owing to the opposition of various interests. Mr. Greathead therefore decided to make a deep tunnel, which he built by means of a «shield,» such as is commonly employed in deep turned work in soft soil.

The advantage attending tubular construction is that it can be carried on without the interruption of surface traffic, but the disadvantages are that elevators must be installed to carry passengers between the platform and street surface, a distance varying usually from 50 to 100 feet, with the attending cost and delay, and the greater difficulty of properly ventilating the deep tubes. On the other hand, a subway built close to the surface of the street, whether by tunneling or in open excavation, introduces many complex difficulties, as there are involved the interference with street travel, and the care and at times extensive reconstruction of other sub-surface structures, such as sewers, pipes or electric conduits.

In Boston these difficulties were avoided in some instances by tunneling with the aid of a semi-circular shield, and elsewhere reduced, as a rule, by keeping the roof of the subway sufficiently low to pass beneath the water and gas mains, so that they were left in their previous positions. When tunneling methods were not employed, surface travel was maintained by permitting the contractors to break the continuity of the surface during the night only. The first step was to make an excavation across the street and with a length of about 12 feet. This excavation, roofed over with wood during the day, was carried down to the foundation level and a section of the subway structure built. Such an excavation was called a «slice.» After the first slice was well advanced, a second was begun, and an intervening slice interval left undisturbed. When a series of alternate slices were completed the intervening excavation was removed.

In Paris, subway construction was much aided by the width of the streets and the placing of nearly all sub-surface structures beneath the sidewalks. In New York, in order to reduce to the minimum the distance between the platform and street surface so as to give the shortest flight of steps for passengers to climb, it was planned to build the old subway regardless of sewers and pipes, even though extensive readjustment was necessary. A general design of a flat roof was adopted, the top of which was permitted to come within 30 inches of the top of the paving, a distance just sufficient to contain the yokes carrying the sub-conduit of the electric surface tramway. In order to support the flat roof with its superincumbent load, a steel framework was devised, consisting of horizontal steel beams in the roof resting on rows of columns between the tracks and vertical steel beams at the sides. These steel frames were set at intervals of five feet, and provide a series of supporting ribs. Between the roof beams and again between the wall beams, arches of concrete were formed. The floor of the structure is also of concrete, reinforced with steel beams, whenever an upward hydrostatic pressure was present. At the sides and immediately next to the wall columns were placed two vertical rows of terra-cotta ducts, into which were drawn, through manholes leading to the street surface, the lead-covered cables to carry the power current for operation. In order to keep moisture from the subway a layer of water-proofing material consisting of felt and asphalt was laid in the floor concrete and then carried up outside of the ducts and over the roof, making a continuous envelope. Immediately outside of the waterproofing was laid a thin protective wall of brick in concrete in order to guard it against damage. For the special difficulties incident to the tunnel construction of the New York subways see TUNNELS AND TUNNELING — *New York Rapid Transit Tunnels.*

The bringing of the subway close to the surface necessitated carrying surface traffic during construction, usually by means of temporary bridges, and the permanent readjustment of subsurface structures. In the matter of sewerage, this readjusting was done by substituting for a single sewer in the centre of the street, two smaller sewers, one on each side, and by carrying cross sewers in iron pipes beneath the subway at suitable points. In the matter of water and gas mains, pneumatic tubes and electric conduits, a complete rearrangement was adopted by leaving the smaller ones above the roof and placing the larger ones at the sides. A satisfactory arrangement of these sub-surface structures was a work of great difficulty and expense.

In general the design of this old subway proved very satisfactory, yet in operation certain defects developed which were avoided by the engineers of the Dual System. Many of the stations of the old subway were built on curves. A considerable space was left between the car and station platform on these curves which proved a source of constant danger in rush hours and were the cause of not a few fatalities. Moreover, it is necessary to slow down sooner when approaching a curved platform than a straight one, and in the rush hours, when trains are operated on short headways this slow-down tends to cause congestion at those points of the line where there are curved platforms. The ventilation of the old subway was defective in that all four tracks were placed in one tunnel. The passage of a train there stirred the air, but did not renew it, since the air escaped to the side of the train and was not propelled ahead of it to the exhausts. The new subways have a partition between each pair of tracks, so that there is really a tunnel for trains going in the same direction and one for those going in the opposite direction. Excessive heat developed in the old subway in the summer. This is due to friction of wheels, brakes, etc., and to the operation of the car motors. The old subway was waterproofed all the way around — underneath, at the sides and overhead—and this waterproofing, while most effectively keeping water out, prevents radiation and confines the heat within the tunnel, which is augmented by each passing train. Less waterproofing characterizes all recent subway construction.

On the old New York subway there are two classes of stations, one for local, the other for express trains. The platforms of the local stations are on the outside of the outer pair of tracks, and are reached directly from the street surface, and at these points there is no connection with the express (the central) tracks. At the express stations, the local (outer) tracks are curved outward so as to permit the construction of an island platform between each local and express track. The station stairways in this case are located as before, on the sidewalks and lead to a ticket office beneath the street, from which there leads a bridge passing over the tracks and connected with both the island platforms by stairs. The more important stations cover two streets and have numerous exits and entrances. Straight platforms exclusively are built on the new lines. The openings at subway stations were assumed to be sufficient to provide for ventilation of the subways; but this proved an error, and numerous openings were added, as well as blowers at congested points. See NEW YORK CITY.

The cost of constructing subways is very great. In this respect, the New York subway, being the largest and most complete as yet constructed, has cost (including all work in hand estimated complete) about $400,000,000. This figure includes many miles of surface and elevated tracks allied with the system, and the usual proportion of «water» for financing the proposition. The most expensive four-track section cost at the rate of nearly $5,000,000 per mile. In Boston 1.7 miles of subway, a part of which was four-track, cost $4,250,000. In Paris the cost averages for two-track subway about $850,000 per mile, while in London tubular railways cost about $1,500,000 per mile, without equipment in all cases.

Operation.— As stated above, the first subways built in London were worked by steam locomotives. All lines subsequently constructed, except one in Glasgow, have been and are operated by electricity. In the exception above noted a cable was the source of power. As the original lines are now being converted to electrical operation, it has become the sole power now in use. The power is generated in central stations by direct driven generators, usually of large size. The largest central station so far constructed is the station built to operate the subway in New York. In this station there are eight units, which have nominally 5,000 kilowatt capacity each, and which, together with subsidiary engines, represent a total of 132,000 horse power.

The current as produced is, according to the most approved practice, of the three-phase alternating type, and at a pressure of from 6,000 to 11,000 volts. This current, in appropriate substations, is transformed and converted into direct current at a pressure of about 550 volts, and as such is fed to the line. The means of delivering the current to the trains is usually by means of a third rail set on the floor of the subway, and at a distance of about two feet from one of the track rails. From this rail the current is taken by contact shoes on the motor cars and led to the motors themselves. On some railroads the trains are drawn by electric locomotives at the head of the train, coupled in the same manner as steam locomotives. The most desirable practice, however, is to distribute the power to various cars in the train, so that the weight of the cars and passengers furnishes the necessary track cohesion. This method of working is called the multiple unit system. The various motors thus distributed through the train are controlled from either end of the train or can be arranged so as to be controlled at any intermediate point. In the New York subway the most powerfully equipped cars as yet constructed are in operation. The motor cars have each two 200 horse-power motors, and are adapted so that the express trains can be composed of five to seven motors and three trailers. The total weight of an eight-car train, including passengers, standing space occupied as well as seats, is about 300 tons. The nominal power capacity is, therefore, six and two-thirds horse power per ton of train, or, say 10 horse power per ton of train available during the short period of acceleration. This power capacity is greatly in excess of European or other American practice on account of higher speed to be realized. Inasmuch as subways are built to convey large numbers of passengers, it becomes necessary that the cars be run in trains and not in single units, except in the case of Boston, where the subway was built for the passage of the surface trolley cars. The trains vary in length from 2 to 10 cars.

Ownership.— The various subways in London, as well as in Glasgow, Berlin and Budapest, are the property of private corporations. In England the authorization for such companies has to be procured by a special bill passed through Parliament, the ownership of the work being vested in perpetuity in the corporation, the various powers of the corporation being expressed in the act.

New York, Boston and Paris adopted the principle of municipal ownership, but under different methods of application. In New York the Dual System was created when the city through the Public Service Commission, on 19 March 1913, entered into an agreement with the Interborough Rapid Transit Company and the New York Municipal Railway Corporation (the latter a subsidiary of the Brooklyn Rapid Transit), providing for the construction and operation of new subway lines, elevated and subway extensions, of existing subways, and third tracking and extensions of elevated lines. The city and the two companies contributed large sums for the construction of subway lines, while cost of equipment, plus the cost of construction of elevated extensions and elevated third tracking and other improvements, was met by the two companies on their respective systems. Despite the substantial contributions by the companies to the expense of subway construction, all subways and elevated extensions of subways are owned by the city, while elevated railroad extensions and third tracking on elevated railroads remain the property of the companies. The dual agreements included leases to the companies of the lines to be operated by them and their subsidiaries.

In Boston a commission appointed on behalf of the city constructs the road by contracts as cheaply as possible and makes a lease to the company owning and operating the surface and elevated lines at a figure that will at least return to the city the interest that the city has to pay. In the case of both New York and Boston the profit that the municipality reaps is the securing of the construction of rapid transit lines necessary for the development of the city.

In 1918 the Boston operating company found itself in financial difficulties due to a variety of causes and appealed for aid to the State legislature. An act was passed by the latter body vesting a board of five trustees with power to operate the Boston system and to fix the fare rate. For the first six months of control by the board from 1 July 1918 the success of the experiment was questionable. The fare has since been increased 100 per cent and agitation for public operation has decreased proportionately. Boston's subway now extends to all parts of Greater Boston and to Cambridge, Mass.

In Paris the city arranged with a corporation especially organized for the purpose, the leasing of all lines that the city of Paris might build, the company to pay to the city one-third of the gross receipts, and, in addition, to furnish the equipment, which will become the property of the city at the end of the lease without payment. The city of Paris then constructs in its own name the several lines, which must conform to a certain standard of excellence. The company has no supervision of the construction of the lines, as it is not directly interested in the cost. The city of Paris is not secured against loss, as in the case of New York and Boston, but, on the other hand, being practically a partner in the enterprise, it can secure a direct monetary profit, provided the roads are profitable in their operation, which have so far been found to be the case. Chicago and Philadelphia are building subways, construction is well advanced in the latter city. Chicago proposes to spend $100,000,000 in a nine-year building plan, involving the construction of a double-track rapid transit subway six miles in length and a five-mile subway for street surface cars. These subways would be the nucleus of a larger system to be constructed later, which provides for 58.1 miles of subway. Consult Beavan, A. H., 'Tube, Train, Tram and Car' (New York 1903); McPherson, L. G., 'Transportation in Europe' (New York 1910); Johnson, E. R., 'Elements of Transportation' (ib. 1909). See also TUNNELS AND TUNNELING.

SUCCESSION. Succession is the transmission of property either real or personal at the death of the owner, by rules laid down by law, in distinction to that by will made by the deceased. The term «succession» is used in law to cover both the technical word «descent,» which applies to real property, and «distribution,» which applies to personal property.

When the owner of property dies, it is presumed that his property will follow in its succession the rules laid down by law, unless it is shown that a will is in existence. This fixes great responsibility upon the law to be just and fair to the survivors, and the statutes of the different States are very carefully worded to cover the rights of all. In all of the States the statutes of descent and distribution show conclusively how property will be disposed of by administers of estates. The statutes vary in some points, but in most provisions they follow the old common law of England and the Roman civil law.

Family ties form the base on which are built up the laws of succession. Children of the deceased (known as the «intestate» from the fact of not having made a will or testament regarding his property) have the first right in the property. In the United States, except where modified by statute, the heirs or persons who inherit through the laws of succession, take both the real and personal property, the only distinction being that the real property vests at once and the personal is distributed by administrators.

Children, male and female, share alike in the property of the ancestor, and if one or more of the children is deceased, the grandchildren will take that share that would have fallen to their parent, so long as one child of the ancestor lives. If there are no children living, and only grandchildren, all the grandchildren will share and share alike regardless of the apportionment that would have taken place if their parents had lived. The former is known as «per stirpes» or by representation; the latter as «per capita» or by the number of persons.

Property will first descend in a direct line as long as there are descendants, such as to children, grandchildren and their descendants. These are known as lineal descendants.

It will then go to brothers and sisters of the full blood and to the half blood of the same father, and their descendants. Failing these descendants, it will ascend to the parents and their descendants who are not in the direct line with the intestate, and are known as collateral descendants. Property will descend to even remote kindred before it will ascend one generation.

Where there are no children the husband or wife inherits in some States the entire estate personal and real, but in other States the personal property only is inherited, and the realty descends to the blood of the intestate, a life interest known as dower only vesting in the widow.

The rights of the half blood are settled by statute. Half-blood brothers and sisters inherit from the common ancestor, but not of the parent by marriage.

Where lineal descendants fail, the succession is counted from the common ancestor with the intestate who last owned the property by right of «purchase» rather than by descent. This rule is enforced in order that ancestral property shall not be diverted from its original source.

In the United States there is no preference in descent for male rather than female heirs, nor for first born.

If there are not found any lineal descendants, or any collateral descendants to take the property, the succession fails and the property reverts or «escheats» to the State or county.

Adopted children are treated as not capable of inheriting property other than that of the adopting father and mother, and are not included in succession from other members of the family, either ancestors or brothers or sisters.

A child born after the death of the father is included in the inheritance as if the birth was before the death of the father, if the child is born alive, and the share taken is the same as others of the children.

A bastard may not inherit except from his mother or illegitimate brothers or sisters. Being illegitimate, the law does not recognize rights due him. If legitimized by special act of legislature or subsequent marriage, he takes then in the same share as any legitimate child.

Personal property is distributed according to the laws of the place where the intestate has his domicile. The realty descends according to the laws of the State in which the property is situated. Modern European civil codes differ widely in their provisions regarding inheritance and succession. In general the principles of Roman law obtain. See DESCENT IN LAW; HEIR; INHERITANCE.

SUCCESSION, Apostolic, the transmission, through the episcopate, of the power and authority given by Christ to his apostles for the governance of His church. Theologians of the Catholic Church and of the Anglican High Church maintain that those sects which are without apostolic succession, that is, which separated from the Catholic Church without retaining bishops regularly ordained and consecrated, have, strictly speaking, neither church nor sacraments, nor divine mission to teach their people the truths of the Christian religion. Catholic theologians hold further that apostolic succession by itself does not involve the authority to teach, to rule the church, to administer the sacraments; that when, for example, a national church goes out of the communion of the Church Catholic, though it have duly consecrated bishops, and duly ordained clergy, by being severed from the Church Catholic it loses jurisdiction, mission, right to exercise the powers of priesthood and episcopacy; its bishops and priests are in a situation resembling that of a bishop or a presbyter who is suspended or excommunicated. See Bishop; Ordination; Catholic Church.

SUCCESSION POWDERS, from the French *Poudres de Succession,* secret poisonous powders formerly prepared in Italy and France, to kill persons slowly, so that their heirs might succeed (hence the name) to their property and personal estate. Private enmities also found these powders a ready and secret means for satisfying the treacherous desire for revenge. Their composition has never been definitely established, but the principal active ingredient is now known to have been arsenious acid, or common white arsenic; then unknown except in the laboratories of a very few chemists. A reference to these powders may be found in Beckmann's 'History of Inventions, etc.,' translated by Johnson (Vol. I, chapter *Secret Poison*). Consult Stenzelii, 'Dissertationes de Venenis et Temporaneis,' resp. J. G. Arnold, Vitebergæ, 1730.

SUCCESSION WARS are wars which arise from claims for the possession of the crown on the occasion of a sovereign dying without undisputed legal heirs. In modern European history the most important of these struggles were those of the Spanish succession (1700–13), and of the Austrain succession (1740–48).

War of the Spanish Succession.— Shortly before the death of Charles II of Spain, without issue or collateral male heirs, several competitors laid claim to the throne, the two principal being the dauphin of France, son of Charles' elder sister; and the Emperor Leopold, who first claimed as male representative of the younger branch of the house of Austria, being descended from Ferdinand, second son of Philip and Joanna of Castile, though he afterward withdrew this claim and substituted another in right of his mother, Mary Ann, daughter of Philip III of Spain. The other leading powers, Great Britain, Germany and Holland, were naturally deeply interested in the settlement of this question, for the union of either France or Austria with Spain, which at that time ruled over the Netherlands, the Milanese, Naples and Sicily and vast territories in America, would have seriously endangered the balance of power in Europe. After much negotiation which had little result, Louis XIV put forward his second grandson, Philip of Anjou, as the representative of the French claim, and Leopold nominated his second son Charles as his substitute, both parties solemnly promising that Spain should never be incorporated with their respective dominions. Charles of Spain's second consort, Mary Ann of Neuburg, being a sister of the empress, naturally promoted the views of Leopold; in which, however, she was opposed by the Count d'Harcourt, a clever diplomatist sent by Louis to Madrid, and who conciliated many of the nobles and grandees, whom the queen had alienated. The French ambassador also intimated a resort to force if the rights of the children of France should be superseded. Thus the king of Spain was induced to recognize Philip of Anjou as his heir, 2 Oct. 1700. On 1 November the king died, and the Junta immediately caused Philip to be proclaimed at Madrid. The young king entered his capital 18 February. All the European provinces and all the American possessions of the Spanish empire recognized the new monarch nor was his title at first disputed by the greater part of the European powers. But the measures of Louis excited suspicion and gave offense. On the death of James II of England, the French king recognized his son the Old Pretender as James III; the new works which the French were constructing on the Dutch frontier alarmed the States-General, and on 15 May 1702 England and Holland allied themselves with Austria and declared war against Louis XIV and the "usurper" of Spain. The contest had, however, been already opened by Austria unaided. Prince Eugene descended into the plains of Verona at the head of 25,000 men about the end of May 1701, defeated the French under Catinat at Carpi (9 July), and under Villeroi, at Chiari (September), but this severe fighting had no adequate result. In the following summer Marlborough led an Anglo-Dutch-German army into Belgium and reduced one by one the French fortresses on the Maas; the German states, which, with the exception of Bavaria and Cologne, had been gained by Leopold, sent out an army under the margrave of Baden, which crossed the Rhine and captured Landau. Early in September the elector of Bavaria raised an army and endeavored to effect a junction with Villars, who was sent by Louis to co-operate with him, but they were both kept in check by the margrave of Baden. In 1703 Marlborough, whose actions were hampered by the delegates of the States-General, confined himself to reducing the strongholds held by the French in the low countries. In Germany the elector of Bavaria drove the Austro-German armies out of his dominions, and formed a junction with Villars. The latter advised a rapid march upon Vienna, which might have then been easily captured, but the elector preferred to attack the Tyrol, where the French general Vendôme, with half the army of Italy, was to meet him. The Tyrolese, however, rose against the Bavarians and compelled the elector to retreat before Vendôme could join him. The elector again united his forces with those of Villars, and inflicted a severe defeat on the Imperialists at Hochstedt (20 September); but many misunderstandings arose between the two commanders, and Villars in disgust obtained his recall. In the following year Eugene and Marlborough joined their forces at Donauwörth on the Danube, and coming up with the Franco-Bavarian army under Tallard, Marsin, and the elector, at Blenheim, inflicted upon it a severe defeat, 13 August. In consequence of this decisive victory the French had to recross the Rhine and evacuate all Germany. On the 4th of the same month Gibraltar had been taken in a few hours by a party of English sailors. The campaigns of Marlborough in the Netherlands and of Eugene in Italy in 1705 have no feature of interest. In Spain the English under the Earl of Peterborough captured Barcelona, and had the archduke proclaimed king as Charles III. The year 1706 was disastrous to the French arms. In Italy the united forces of Eugene and the Duke of Savoy fell upon the French while they were besieging Turin, and gained a complete victory, all the siege artillery falling into their hands (7 September). All Lombardy submitted to the Imperialists, and Charles III was proclaimed at Milan. In the Netherlands, Marlborough routed the French under Villeroi at Ramillies (23 May), and was prevented from besieging Dunkirk only by the jealousy of the Dutch. In 1707 an Anglo-Portuguese army under the Earl of Galway entered Spain, but was met by a much superior Franco-Spanish force under the Duke of Berwick at Almanza, and completely defeated (25 April). In southern Italy the whole kingdom of Naples submitted to a small Imperial army under Daun. Nothing of importance took place in the Netherlands or Germany. Eugene and the Duke of Savoy, penetrating into France by the Maritime Alps and Nice, appeared before Toulon toward the end of July, but the approach of some strong French divisions compelled them to retreat with considerable loss. In the following year Marlborough and Eugene, according to a fixed arrangement, reunited their forces in the Low Countries, and coming up with the French under the Duke of Burgundy and Vendôme at Oudenarde inflicted on them a severe defeat (11 July). The allies then entered French Flanders, and laid siege to Lille, its capital, which capitulated 22 October. On the Rhine both sides remained on the defensive. In Spain Charles III was compelled to shut himself up in Barcelona. The island of Sardinia submitted to Admiral Lake in August, and in the following month Minorca was captured by Lake and General Stanhope. The length and ill success of the war had now begun to tell with fatal effect upon France. The funds required for the equipment and support of the armies were raised by ruinous loans, injudicious and vexatious taxes, the forestalment of future revenue and the issue of paper money and a debased coinage. A severe winter destroyed the corn, vines and fruit-trees, and the dearth and famine which ensued produced discontent and sedition. Louis XIV sued for peace, offering to give up, in the name of his grandson, the whole of the Spanish succession, and to restore Strassburg to the empire; but the allies looked upon these overtures as mere tricks to gain time, and rejected them. Both sides now made extraordinary preparations for renewing the struggle. Villars was sent into Flanders with an army of nearly 100,000 men to oppose Marlborough and Eugene, whose combined strength was slightly superior. After capturing Tournai, the allies proceeded to invest Mons. For this purpose they had to attack Villars in a strongly fortified position at Malplaquet, from which they succeeded in driving him, but not without suffering enormous loss (11 Sept. 1709). After some more fighting, besieging and negotiating, the death of the emperor, Joseph I, son and successor of Leopold, without male issue, leaving his crown to his brother Charles, changed the whole aspect of affairs. The British thought that if Charles became undisputed sovereign of Spain and her dependencies, the very evil of an almost universal monarchy would be again established, the prevention of which had been the chief cause for taking up arms against Philip V. A new Tory ministry unfavorable to Marlborough having come into power, private preliminaries of peace were signed between France and England 8 Oct. 1711. Eugene, however, continued the war aided by the Dutch, and was pushing steadily forward on Paris, but the defeat and capture of the British contingent under the Earl of Albemarle at Denain by Villars (24 July 1712) so weakened his forces that he was compelled to retreat. This defeat greatly modified the views of the Dutch, and the English government persuaded the States-General to moderate their demands and come to terms with France. On 11 April 1713, the Dutch plenipotentiaries signed a treaty of peace (Peace of Utrecht) with France, their example being immediately followed by Prussia, Savoy and Portugal. Forsaken by all his allies, the Emperor Charles was reluctantly compelled to sign a treaty at Baden, 7 Sept. 1714, in which he recognized Philip V as king of Spain.

War of the Austrian Succession.— On the extinction of the male line of the house of Hapsburg, by the death of Charles VI (20 Oct. 1740), his eldest daughter, Maria Theresa, in terms of the Pragmatic Sanction, (q.v.) claimed the whole of his dominions, and at once assumed the government, with the title of Queen of Hungary and Bohemia. The announcement of her accession was answered by England, Russia, Prussia and the States-General with assurances of friendship and good-will. France returned an evasive answer; Charles Albert, elector of Bavaria, refused to acknowledge the queen of Hungary until his pretensions to the Austrian succession were examined and decided. He appealed to two ancient documents — the marriage contract between Albert V, Duke of Bavaria, and Anne, daughter of the Emperor Ferdinand I, and the testament of that monarch; and he contended that by these two deeds the succession was assured to Anne and her descendants in default of male heirs, the issue of the archdukes, her brothers. Maria Theresa, however, having called together the foreign ministers at her court, caused the testament to be read before them, when it turned out that it spoke not of the extinction of the male issue of Ferdinand's sons, but of their legitimate issue. The first blow against the young queen came not, however, from any claimants of her inheritance, but from a sovereign who had already acknowledged her right. This was Frederick II of Prussia, who, in the middle of December 1740, invaded Silesia at the head of 30,000 men, to sustain an old family claim on four duchies in that province. On the condition that Maria Theresa would cede to him all Silesia, he promised a close alliance with himself, in conjunction with the maritime powers and Russia, his assistance in upholding the Pragmatic Sanction, his vote for her husband as emperor, and an advance of 2,000,000 thalers, but the high-spirited queen, determined not to begin her reign by dismembering her dominions, gave these offers a flat refusal. Owing to an exhausted treasury and a disorganized army, all Silesia, with the exception of Glogau, Brieg, and a few other places, was overrun by the end of January 1741. A severe winter hindered further operations for a time, but on 9 March the Prussians took Glogau, and pushed toward Jägerndorf. The advance of three bodies of Austrian troops from different quarters now threatened to hem in the Prussians; and to maintain his communications with Lower Silesia, Frederick had to risk a battle at Mollwitz, in which his forces were victorious (10 April). This victory called into action those powers that had postponed their schemes till they had learned the issue of Frederick's attempt. France put herself at the head of a confederacy of all the claimants to the Austrian dominions, the principal among whom were the electors of Bavaria and Saxony, sons-in-law of the Emperor Joseph I; Philip V of Spain; Charles-Emmanuel of Sardinia, who claimed the Milanese, and Frederick II of Prussia, who demanded all Silesia. To this formidable coalition Austria could oppose only a few allies. England granted her an annual subsidy equal to $1,500,000; the Dutch were arming in her favor; the mixed population of Hungary and the peasants of the Tyrol rose almost in a mass. Toward the end of June the Bavarians entered the Austrian territory, overran Bohemia, and being joined by the French under Belleisle, occupied Lintz, the capital of Upper Austria, without striking a blow. Alarmed by this invasion Maria Theresa bought the neutrality of her most formidable foe, Prussia, by the cession of Silesia and the county of Glatz. On 24 Jan. 1742, the elector of Bavaria was unanimously chosen emperor, with the title of Charles VII, but at the moment when he had attained the object of his ambition his fortune began to turn. Khevenhüller at the head of one Austrian army, advanced up the valley of the Danube, captured a Franco-Bavarian corps 12,000 strong in Lintz (24 January), invaded Bavaria, and on 13 February took possession of Munich, only a day or two after Charles VII's election to the imperial throne had been celebrated there. Another Austrian army under the grandduke of Tuscany kept the French in check in Bohemia. The successes of Austria alarmed Frederick II for the security of his new acquisitions, and he suddenly broke the treaty, poured his forces upon Moravia and Upper Austria, and defeated the Austrians under Prince Charles of Lorraine at Czaslau (17 May). But Frederick was not inclined to push his victory further, he once more made peace with Austria (11 June), and his example was followed by the elector of Saxony. In consequence of these arrangements the French under Belleisle, left without the co-operation of the Saxons, were forced by the maneuvers of Charles of Lorraine to shut themselves up in Prague, where Maillebois, with the French army, was defeated in endeavoring to relieve them. Only 12,000 of the 60,000 men whom Belleisle led into the campaign succeeded in escaping from Prague and making their way into France early in 1743. In the May of that year Bavaria was again occupied by the Austrians under Prince Charles and Khevenhüller. An Anglo-German army of 40,000, under the Earl of Stair, crossed the Maas and Rhine in March and April, in order to cut off the Bavarian army from France, and coming up with the French under Marshal Noailles at Dettingen completely routed them (27 June), but did not know how to profit by their victory, and nothing was done during the remainder of the campaign. The year 1744 brings with it a new phase of the war; France and Great Britain, which up till this time had been engaged in the struggle merely as allies, declared war against each other. In February a descent was attempted on England, but Admiral Norris, aided by a tremendous storm, proved too strong for the French fleet and the English proceeded to destroy gradually the shipping of the French, and that of their allies, the Spaniards. As a compensation Marshal Saxe conducted a splendid defensive campaign in the Netherlands. Meanwhile the successes of Austria on the Rhine, and the ill-concealed regrets of Maria Theresa for the loss of Silesia, again alarmed Frederick for his possession of that province. He accordingly entered into an alliance known as the Union of Frankfort (22 May), with the emperor, the elector palatine, and the king of Sweden, as landgrave of Hesse-Cassel; a secret treaty was also signed with France, 5 June. A Prussian army of 80,000 men was at once poured into Bohemia, which for a time carried all before it, capturing the capital Prague after a siege of six days, 16 September. The junction of a superior Austro-Saxon force however, and the hostile attitude assumed by the Bohemian population compelled Frederick to quit the kingdom with considerable loss. To avenge this attempt upon Bohemia the Austro-Hungarians broke into Upper Silesia and Glatz, from which the Prussians were almost totally expelled before the end of the year; but before the spring of 1745 the territory was again occupied by the Prussians. Frederick's unsuccessful invasion of Bohemia had proved of service to the emperor, as it compelled the Austrians to return from Alsace, and thus allowed time to recover his electorate of Bavaria. The Italian campaign of 1744 was unfavorable to the Austrians. In the preceding year they had driven the Spaniards almost to the Neapolitan frontiers, and seemed to threaten an invasion of Naples itself. To avert such a catastrophe Don Carlos joined the Spaniards with his forces, and enabled them to drive the Austrians and Sardinians out of the papal territories toward the Po. On 20 Jan. 1745, the Emperor Charles VII died, an unexpected event, which changed the face of affairs. He was succeeded in the Bavarian electorate by his son, Maximilian Joseph, then only 17 years of age. Being too young to make any pretensions to the imperial crown, and the war going so unsuccessfully for his cause, his subjects loudly demanded a termination of their miseries, and he accordingly concluded a peace with Austria, 22 April. The king of Prussia having now no other ally but France, remained on the defensive for a considerable part of this year. He intrenched himself near Jauernik, on the Bohemian frontier, and awaited the approach of the Austro-Saxons. Prince Charles, who commanded them, advanced by Landshut into the plains of Hohenfriedberg, where he was unexpectedly attacked and defeated by Frederick, near Striegau (4 June). Charles retreated into

Bohemia followed by the Prussians, and another battle was fought at Storr, which again went against the Austrians (20 September). About this time the queen of Hungary conceived the bold plan of detaching 10,000 men from the army of the Rhine, who, supported by the Saxons, were to march upon Berlin; while Prince Charles was to attack the Prussian king in his winter quarters in Silesia with another army. Hearing of this project, Frederick determined to anticipate it by an advance into Saxony. About the end of November he entered Lusatia, reduced that province, and marched upon Dresden. The king of Poland (the elector of Saxony) fled to Prague, while Frederick's veteran lieutenant Leopold of Dessau entering Saxony by way of Halle, took Leipzig and Meissen, defeated the Saxon army at Kesseldorf (15 December) and joined the king before Dresden, which capitulated 18 December. Maria Theresa was now compelled to listen to the appeals of the elector of Saxony, as well as to the British Cabinet, which threatened to withdraw its subsidy unless she made peace with Prussia. Frederick was willing to come to terms, feeling that he could not depend on the assistance of France, and that he was unequal to another campaign, his money being almost exhausted. The Peace of Dresden (25 December) assured him of Silesia and Glatz, the cession of which was guaranteed by England, and of an indemnity of $1,000,000 from Saxony. As elector of Brandenburg Frederick adhered to the election of Maria Theresa's husband as emperor, with the title of Francis I. Meanwhile the French under Marshal Saxe carried all before them in Flanders. The battle of Fontenoy, gained over the Duke of Cumberland and Field-Marshal Königseck (11 May), was followed by the capture of Tournai, Ghent, Bruges, Oudenarde, Nieuport and Ath. Little was done on the side of the Rhine. The Italian campaign of this year was unfavorable to the Austrians. The Spanish-Neapolitan army, now joined by the Genoese and Modenese, and numbering in all 70,000 men, overran the whole of Lombardy and the greater part of Sardinia, compelling the king to seek refuge under the walls of his capital; but in the following year (1746) the battle of Piacenza, gained by the Austro-Sardinians over the Franco-Spanish forces (16 June), compelled the latter to relinquish all their conquests and recross the Alps. On 9 July died Philip V of Spain, and was succeeded by Ferdinand VI, one of whose first steps was to recall his forces from Italy, and the French, unable to hold out against their enemies, retreated across the Var, which left Genoa at the mercy of the Austrians, 6 September. Marshal Saxe continued his career of conquest in Flanders, and in 1747 he entered and overran Dutch Flanders, defeated the Duke of Cumberland at Laffeld (2 July), while his chief engineer, Count Löwendahl, captured, after a siege of two months, the important fortress of Bergen-op-Zoom, deemed by the Dutch impregnable. Meanwhile it was evident that the war was drawing to a close. Though great preparations were being made for another campaign, negotiations had been going on during the winter, and a congress had been appointed to meet at Aix-la-Chapelle, whose first conference took place 24 April 1748. Great Britain and Holland were weary of the war; France and Spain were almost exhausted, and preliminaries of peace were signed between these powers (30 April); Austria, thus deserted by her allies, grudgingly consented to sign, 18 May; and the definite Treaty of Aix-la Chapelle was signed by the French, English and Dutch Ministers on 18 October, and in a few days after by those of Spain, Austria, Genoa and Modena.

The War of the Bavarian Succession, between Austria and Prussia, which lasted but little over one year, ended in the Peace of Teschen, 13 May 1779, the elector palatine Charles Theodore retaining possession of the Bavarian dominions. See Aix-la-Chapelle, Treaties of Peace Concluded at; Austria; Bavaria; Frederick II; Maria Theresa; Polish Succession War.

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SUCCINIC (sŭk-sĭn'ĭk) **ACID**, amber acid, $C_2H_4(COOH)_2$, was first obtained by Agricola (1657) by distillation of amber. It occurs in lignite and fossil wood, in many varieties of plants, in the urine of many animals, and in small quantities in the products of the fermentation of sugar with yeast. In this case it is not a product of the sugar but of the antolytic fermentation of the protein substance of the yeast cells, first into glutamic acid, and the subsequent conversion of the latter into succinic acid. It is usually prepared by the oxidation of fats with nitric acid or by fermentation of calcium malate. A colorless crystalline substance with no odor and a slightly acrid taste; soluble in water or alcohol; melts at 360° F.; heated to boiling point, 502° F., it slowly loses water, forming the anhydride $C_2H_4(CO)_2O$. It is a dibasic acid forming salts and many other derivatives. The sodium salt has been used in cases of catarrhal jaundice and gallstones. The other derivatives are of interest only to the synthetical chemist. The principal economic use of succinic acid is in its combination with the rare earths of the yttrium group through whose fractional crystallization these rare elements are secured separately.

SUCCINITE. See Amber.

SUCHET, sü-shā, **Louis Gabriel**, Duke of Albufera da Valencia, French military officer: b. Lyons, 1779; d. 1826. He entered the military service at an early age and passed rapidly through the inferior ranks. In 1796 he was attached to the army of Italy and attracted the notice of General Bonaparte, by his courage, boldness and caution, being made brigadier-general for distinguished bravery at the battle of Neumark in 1797. He then served with distinction under Massena and Joubert and was one of the most active and successful of Napoleon's generals in the campaigns of 1805 and 1806. In 1808 he received the command of a division in Spain and was almost constantly victorious till after the battle of Vittoria. His brilliant services in that country obtained him the marshal's staff and the title of duke. After the overthrow of Napoleon in 1815 Suchet was shorn of his honors but the rank of peer of France was restored to him in 1819. He left unfinished his ‹Memoirs of the War with Spain.› These were published in 1829.

SUCKER STATE, The, a popular nickname for the State of Illinois, whose inhabitants are sometimes dubbed «suckers» by their fellow citizens of neighboring States. The following is the reputed origin of the epithet:

> "The western prairies are full of the holes made by the crayfish, which burrows to reach the water beneath the soil. In the early days of the country's settlement travelers armed themselves with slender hollow reeds, which they thrust, when thirsty, into these natural reservoirs, and thus easily supplied their longings by sucking the water through the reed or pipe.";

SUCKERS, soft-rayed teleostomous fishes of the genus *Catostomus* and related genera belonging to the family *Catostomidæ* (q.v.). The family is extremely characteristic of the fresh waters of North America, where all but two of the 60 or more species are found, replacing in our fauna the carps of the Old World. The 14 recognized genera include, besides the suckers proper, the blackhorse and redhorse, the buffalo-fish, the jumping mullet and the white mullet. Many of these fishes exhibit migratory habits recalling the anadromous marine fishes, moving regularly in the spring from ponds and lakes into the fresher waters of brooks to spawn. As examples of this large group the following may be selected: The common or white sucker (*Catostomus teres* or *C. commersonii*) reaches a length of 15 to 18 inches, has thick protusible lips with two or three rows of papillæ, about 65 scales along the lateral line and a rather short dorsal fin. The color is dusky above, light olivaceous on the side, tinged in the spring with rosy hues. This species is exceedingly common in rivers, mill-dams, ponds, etc., throughout the entire eastern half of the United States. Early in the spring, as soon as the ice is out of the streams, this species leaves the larger bodies of water and deep holes and seeks the swift-running brooks, up which large schools migrate until stopped by some obstruction, to deposit their spawn in the upper stony shallows. At this season they take the hook eagerly, especially when baited with earthworms; but they are listless, lazy fishes and never afford any real sport nor good eating, except for a short time in early spring. In the summer they are soft and tasteless. Many are captured in small nets at sluiceways, etc., or even in the hands by boys who wade in the streams and feel for them under overhanging banks. Hog-sucker, stone-roller (*C. nigricans*) are some of the names of a considerably larger species, with larger scales, found plentifully in the lakes and clear swift streams of much the same region. Its habits are similar and favorite methods of capture are spearing and noosing with fine copper wire or horse-hair. Other related species are the carp-sucker or sail-fish (*Ictiobus velifer*) of the Mississippi Valley, the carp-sucker of the Susquehanna River (*I cyprinus*), the chub-sucker (*Erimyzon sucetta*) and the striped sucker (*Minytrema melanops*) of the Great Lakes and Mississippi Valley. Consult Goode, ‹American Fishes› (New York 1888).

SUCKING-FISH. See REMORA.

SUCKLING, SIR John, English poet: b. Twickenham, Middlesex, 1609; d. Paris, May or June 1642. He was educated at Trinity College, Cambridge, was admitted at Gray's Inn, traveled in France and Italy and essayed to cut much of a figure at court. Apparently he accompanied the Marquis of Hamilton with the contingent of 6,000 for the reinforcement of Gustavus Adolphus and took part in Tilly's defeat before Leipzig (7 Sept. 1631). In 1637 he had his play of ‹Aglaura› presented with large expenditures for its mounting, scenery having, with the exception of masques, been rarely, if at all, used before that on the English stage. He marched at the head of a levy of a hundred horse, recruited by himself, to the Scottish border in May 1639, and he was much laughed at for the gorgeous equipment of his troop. He set on foot the «first army plot,» to obtain command of the army for Charles I, but was betrayed to the opposition and compelled to escape to France. The collection ‹Fragmenta Aurea› (1646) contains all of his work that is of any importance, comprising ‹Poems›; ‹Letters to Divers Eminent Personages›; three plays, ‹Aglaura,› ‹The Goblins› and ‹The Tragedy of Brennoralt,› and a tract on socinianism, ‹An Account of Religion by Reason.› His plays are valuable largely for the interspersed poems. Suckling is called by Aubrey the inventor of the game of cribbage. There is a volume of selections by W. C. Hazlitt (now ed., 1893). Consult ‹Works of Sir John Suckling,› edited by A. Hamilton Thompson (New York 1910).

SUCRE, Antonio Jose de, ān-tō'nē-ō hō-sā' dā soo'krā, Venezuelan military officer: b. 1793; d. June 1830. He entered the insurrectionary army in 1811, and in 1819 he had attained the rank of brigadier-general. With the assistance of the Peruvians under Santa Cruz he gained the decisive victory of Pichincha, 24 May 1822, which was immediately followed by the capitulation of Quito. He totally routed the Spanish forces in the battle of Ayacucho, 9 Dec. 1824, the most brilliant ever fought in South America. Sucre promptly followed up this glorious victory and his troops entered Cuzco on 12 December in triumph. Upper Peru was soon entirely liberated and turned into a republic called Bolivia, of which Sucre was elected President in 1826. An insurrection broke out in 1828 and Sucre was driven from the country; but he returned at the head of a Colombian army and reinstated himself. He was assassinated in the neighborhood of Pasto.

SUCRE, or CHUQUISACA, choo-kē-sā'-kā, Bolivia, the capital of the republic and of the department of Chuquisaca, in the extreme northwestern corner of which it is situated, 318 miles southeast of La Paz. It is now reached by rail from Mollendo, Peru, via La Paz and from Tacná and also from Argentina. It lies on a plateau to the west of the eastern Cordillera, 8,987 feet above the sea, and is surrounded by beautiful mountain scenery. The houses are well built and surrounded by gardens. A fine cathedral and a number of other public buildings testify to the former wealth of the city. Sucre is also the seat of the oldest university in Bolivia, as well as of other high educational institutions. The Supreme Court of Bolivia sits at Sucre. Sucre was founded in 1536 on the site of the Indian village of Chuquisaca. In the Colonial period it was called La Plata and soon acquired great wealth and importance from its rich silver mines. It was later eclipsed by Potosi, but is still the centre of a prosperous mining and agricultural region. Although it is officially the capital, the national government is now chiefly administered from La Paz. Here Bolivian independence was proclaimed on 6 Aug. 1825. The city was later named after Sucre, first President of the new republic. Pop. 24,000.

SUDAN, soo-dän′, or **SOUDAN,** is the Arab name given to the vast extent of country in central Africa which lies between the Sahara on the north, Abyssinia and the Red Sea on the east, the countries draining the Kongo Basin on the south and Senegambia on the west. Its area is estimated at 2,000,000 square miles, and its population at from 10,000,000 to 20,000,000. The inhabitants comprise numerous nations of different races, chiefly the negro, together with Arab colonists and traders. The western and central Sudan are divided into a number of states which until recently maintained their semi-independence. It is now virtually all controlled by England and France. Bambarra, Gando, Sokoto, Adamawa, Bornu, Baghirmi, Wadai and others. The eastern Sudan includes Darfur, Kordofan, Senaar, etc. Egyptian rule was first extended to the eastern Sudan in the early part of the 19th century by Mohammed Ali, under whom Ibrahim Pasha carried it as far south as Kordofan and Senaar. An Egyptian expedition under Sir Samuel Baker in 1870 led to the conquest of the equatorial regions on the Nile farther south than the Sudan proper, of which General Gordon was appointed governor-general in 1874. On the fall of Ismail Pasha of Egypt, Gordon was recalled and hordes of Turks, Circassians and Bashi-Bazouks were let loose to plunder the Sudanese. Egyptian misrule then became intolerable, and in this crisis appeared Mohammed Ahmed of Dongola, who gave himself out to be the Mahdi, the long-expected redeemer of Islam. (See Egypt), Emin Pasha (Eduard Schnitzer) was appointed governor of the equatorial province on the Upper Nile, north of the Albert Nyanza, by Gordon in 1878.

During 1881–82 the Mahdi destroyed nearly every Egyptian force sent against him, but in the spring of 1883 elaborate preparations were made to suppress the rebellion. A well-equipped army, organized and commanded by Colonel Hicks, an old Anglo-Indian officer who had entered the Egyptian service, began its march up the Nile in September with the intention of striking at once at El Obeid, the headquarters of the Mahdi. But, after enduring many hardships, Hicks' army was led by a treacherous guide into an ambuscade and annihilated. Colonel Coetlogon, the British officer at Khartum, at once adopted defensive measures, and called in as far as possible the outlying garrisons. After some further reverses the British government advised the khedive to relinquish the country south of Wady Halfa or the second Nile cataract. English troops were sent out to relieve the garrisons of Eastern Sudan, and General Gordon undertook to effect the withdrawal of the garrisons of Khartum and other places, unaccompanied by English troops. In a short time he was shut up in Khartum, and in the autumn of 1884 a British force under Lord Wolseley was sent up the Nile to effect his relief. This expedition was too late to accomplish its object. Khartum was stormed by the Mahdists in January 1885, and Gordon was butchered.

After the successful revolt of the Mahdi the Red Sea and Somali possessions of Egypt were occupied by Italy and Britain, respectively, and Darfur threw off the Egyptian yoke, but the equatorial province was held by Emin Pasha till he was relieved by Stanley. In 1896 an Egyptian force under the sirdar, Sir Herbert Kitchener, proceeded up the Nile, occupying Dongola on 23 September of that year, and taking possession of Abu Hamed and Berber during 1897. Early in September 1898 the Mahdist forces, under the command of the Mahdi's successor, the Khalifa, were completely defeated at the battle of Omdurman and Khartum was reoccupied by the Egyptian forces. About the same time the question of the southern limit of the Egyptian Sudan was raised by the occupation of Fashoda, a little north of the Sobat River, by a French force under Major Marchand. By an Anglo-French agreement in 1899 the western boundary was drawn so as to leave Wadai to France and Darfur and the Bahr-el-Ghazal to the Egyptian Sudan. In the same year the 22d parallel of latitude was declared to be the northern boundary of the Egyptian Sudan, which is now under the government of Britain.

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SUDBURY, Canada, town and capital of the district of the same name, Ontario, situated to the north of Georgian Bay, on the Canadian Pacific, the Canadian Northern and the Algoma Eastern railroads, 443 miles west of Montreal and 182 miles east of Sault Ste. Marie. The branch to Sault Ste. Marie leaves the main line here. Two short railway lines connect the town with its celebrated mines of nickel and copper. The ores are partly reduced in furnaces near the town. The town is the seat of a government school of mines and of a Jesuit college. Pop. 4,150.

SUDERMANN, Hermann, German dramatist and novelist: b. Matziken (near Heydekrug, East Prussia, 30 Sept. 1857). His father was a brewer, descended from a family of Dutch Mennonites, one of whom was the didactic and moralistic author Daniel Sudermann (1550–1632), who wrote in German. Hermann Sudermann attended the Realschule at Elbing, the Realgymnasium at Tilsit, earning a living at the same time as an apothecary's apprentice, and went to the University of Königsberg, where he studied philology and history until 1877. In the latter year he went to Berlin and became a tutor to various Berlin families, including that of the author Hans Hopfen (1835–1904). He then turned to journalism (his first charge was that of co-editor of the *Deutsches Reichsblatt*, 1881–82), which was to be his introduction to literature. In 1891 he married the authoress Klare Lauckner, a widow (*née* Schulz, b. 14 Feb. 1861). Sudermann later retired to a villa at Grunewald, a suburb of Berlin, and now spends much of his time at his castle of Blankensee, near Trebbin, which the enormous royalties on his plays enabled him to acquire. But his first successes were not in the field of the drama, but in the novel and short story. 'Im Zwielicht' ('In the Twilight'), a volume of short stories, appeared in 1887 (36th ed., 1910), followed in the same year by 'Frau Sorge' (English translation may be had under the name 'Dame Care'), his most famous novel. The latter is a powerful, simply constructed, objective work, excellent in suggestion of tone and milieu, with a somewhat sensational ending. Björnson's story, 'Arne,' was probably used as a model, and Sudermann's work in turn served as the model for Frenssen's great success, 'Jörn Uhl.' The 125th edition of 'Frau Sorge' was printed in 1912. After another volume of short stories ('Die Geschwister' 1888), came another strong but somewhat more vulgar novel, 'Der Katzensteg' (1889; English translation to be had under the title 'Regina'). Although his talent as a narrator is very great, he felt his skill as a dramatist to be greater, and in the same year (1889, which is the year of the opening of the realistic movement in the German theatre (consult articles on Fontane, Gerhart Hauptmann), his first play, 'Ehre' ('Honor') was played in the Lessing Theatre, Berlin, on 27 November. This play, which had been originally intended to be a tragedy, and which, on Blumenthal's advice, had been conducted to a 'happy ending,' was a pseudo-Nietzschean attack on the morality of the lowly and had a great success. The next play, 'Sodoms Ende' (5 Nov. 1890), a tragedy of artistic life in Berlin, was not a success. It was followed by 'Heimat' (7 Jan. 1893), in which Sudermann again emphasizes the right of the artist to a freer moral life than that of the petty bourgeoisie, and which is constructed with such telling dramatic effect, that this play has carried Sudermann's reputation all over the world. Every great actress considers 'Magda' (in English the play is known by that name), the heroine of 'Heimat,' to be one of the touchstones of her profession. There is in this play some of the moralistic and didactic tendency of the later French dramatists, especially the younger Dumas, and all of their technical finesse. Sudermann attempted another long novel, 'Das hohe Lied' (English translation, 'The Song of Songs') in 1908. His latest work of which any report has reached this country is the dramatic cycle 'Die entgötterte Welt' ('The World made Godless'), of which one section, 'Die gutgeschnittene Ecke' (performed at the Lessing Theatre, 28 Jan. 1916), treats satirically of the sordid commercial phases of theatrical art in Berlin. On the whole, Sudermann must be regarded as a seeker for sensational effect and high royalties, in which he has been extremely successful. The permanent value of his work is slight. But its present popularity renders it important to study it as a symptom of the times. His other works are 'Iolanthes Hochzeit' (short story, 1892); 'Es war' (novel, 1894); 'Die Schmetterlingsschlacht' (1895); 'Morituri' (three one-act plays, 1896); 'Das Glück im Winkel' (1896); 'Johannes' (1898); 'Johannisfeuer' (1901); 'Es lebe das Leben' (1902); 'Das Blumenboot' (1905); 'Strandkinder' (1909); 'Der Bettler von Syrakus' (1911); 'Der gute Ruf' (1912). See Magda.

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SUDETIC MOUNTAINS, or **SUDETENGEBIRGE,** soo-dĕ'tĕn-gĕ-brē"gĕ, Germany, a range of mountains running along the northeastern boundary of Moravia and Bohemia, which it separates from Silesia. It rises from the valley containing the headstreams of the Oder, north of the Carpathian Mountains in Moravia, and ends on the southern boundary of Saxony, where the Elbe separates it from the Erz Mountains. Its length is 192 miles. It is a continuous ridge only in its middle portion, which is known as the Riesengebirge. The two ends spread out in the form of plateaus traversed by numerous minor ranges. The slopes are covered with pine forests below which are fertile fields, while the higher summits are bare. The highest point, Schneekoppe, has an altitude of 5,265 feet. The range, which consists mainly of primitive rocks, is rich in minerals, especially iron, lead, copper and zinc. Coal is found in paying quantities in the southeastern quarter of the range.

SUDORIFICS. See Diaphoretics.

SUDRAS. See Caste.

SUDWORTH, George Bishop, American dendrologist and botanist: b. Kingston, Wis., 31 Aug. 1862. He was graduated at the University of Michigan (department of literature and science) 1885; instructor of botany in State Agricultural College of Michigan 1886; botanist in United States Agricultural Department from 1889 to 1898 and dendrologist in the Bureau of Forestry and forest service of the same department since 1898. He has written numerous papers and works on North American trees and is a member of various scientific societies.

SUE, Marie-Joseph Eugene, mä̈rē zhō-zĕf ē-zhän sü, French novelist: b. Paris, 10 Dec. 1804; d. 3 Aug. 1857. He adopted his father's profession of medicine, became a surgeon in the army and served in Spain in 1823. In 1825 he joined the naval service and in the capacity of surgeon was present at the battle of Navarino in 1827. On his father's death in 1829 he inherited an immense fortune and, having abandoned his profession, he devoted himself to literary composition. His first work was a sea novel entitled ‘Kernock le pirate,’ which was quickly followed by ‘Plick et Plock,’ ‘Atar-Gull,’ ‘La Salamandre’ and ‘La Vigie de Koatven.’ He now entered the departments both of historical fiction and the novel of real life. Of the former description were ‘Latreaumont,’ ‘Jean Cavalier’ and ‘Le Commandeur’; of the latter were ‘Arthur,’ ‘L'Hôtel Lambert’ and ‘Mathilde.’ But his most famous works are ‘Les Mystères de Paris’ and ‘Le Juif Errant,’ well known in English as ‘The Mysteries of Paris’ and ‘The Wandering Jew.’ His later novels are ‘L'Enfante Trouvé,’ ‘Les Sept Péchés Capitaux’ and ‘Les Mystères du Peuple.’ In 1850 he was elected to the Constituent Assembly and sat as an advanced radical. After the *coup d'etat* by Napoleon III in 1851 he was exiled and retired to Annecy. See Wandering Jew, The, and consult Mirecourt, Eugène de, ‘Eugène Sue’ (4th ed., Paris 1870).

SUESS, zŭs, **Eduard,** Austrian geologist and seismologist: b. London, England, 20 Aug. 1831; d. 25 April 1914. He studied at the Universities of Prague and Vienna and was appointed (1852) assistant of the Court Mineral Cabinet. In 1867 he was made professor of geometry at the University of Vienna, in the same year being elected member of the Akademie der Wissenschaft, Vienna, of which he was vice-president in 1897, and president from 1897–1911. He wrote ‘Entstehung der Alphen’ (1875); ‘Zukunft des Goldes’ (1877); ‘Zukunft des Silbers’ (1892); ‘Das Antlitz der Erde’ (1883–1901).

SUET. See Tallow.

SUETONIUS, swē-tō´nĭ-ŭs (full name, Gaius Suetonius Tranquillus), a Roman writer, the son of a military tribune, flourished about 100 A.D. Little is known of the circumstances of his life. He distinguished himself as an advocate, obtained the tribuneship through the influence of Pliny the Younger and was appointed secretary to the Emperor Hadrian. His chief works are ‘Vitæ Duodecim Cæsarum’ and the treatises ‘De Illustribus Grammaticis’ and ‘De Claris Rhetoribus.’ The former work gives an interesting account of the 12 first Roman emperors from Julius Cæsar to Domitian and is of great value from the light which it throws on domestic manners and customs. Among the best editions of Suetonius are those of Wolf (1802), Baumgarten-Crusius (1816–18) and Roth (1858).

SUEVI, swē´vī, the general name of a number of united tribes who, before the Christian era, inhabited the greater part of Germany. The Hermunduri, Semnones, Lombards, Angles, Vandals, Burgundians, Rugii and Heruli were the most important, at least the best known. In Cæsar's time they advanced to the Neckar and the Rhine. The Visigoths overcame them entirely in 586 and their empire and name disappeared from Spanish history.

SUEZ, soo´ĕz, Egypt, town on the borders of Arabia, situated at the north end of the Red Sea, and at the south end of the Suez Canal, 76 miles east of Cairo, with which and with Alexandria and other towns it is connected by rail. Formerly it was a small, ill-built, miserable-looking place, badly supplied with fresh water; but the construction of the Suez Canal, and of the fresh-water canal from the Nile, has caused a great change. The fresh-water canal has been taken advantage of for irrigation, which has quite altered the appearance of the land around. In the town the houses, offices and warehouses of European merchants are now to be seen in every direction. Among the principal buildings are the Greek church, viceroy's villa, two hospitals, custom-house, etc. There is here a salt manufactory established by the Egyptian government. A stone pier carrying a railway stretches from the town across an extension of the Red Sea (dry at low water) to Port Ibrahim, at the mouth of the Suez Canal. The population before the construction of the canal was 1,500; at present it is in excess of 18,000.

SUEZ, Gulf of, an arm of the Red Sea, lying along the east coast of the Sinaitic Peninsula.

SUEZ, Isthmus of, an isthmus which unites Asia and Africa, and separates the Mediterranean from the Red Sea; now intersected by the Suez Canal.

SUEZ CANAL. This great canal, which may be said to have converted Africa into an island, runs for nearly 100 miles from Port Said on the Mediterranean to Suez on the Red Sea, forming a channel navigable for large vessels between the two. It is not the first work of the kind constructed in the same locality — a large canal from the Red Sea to the Nile being known to have existed from six centuries before the Christian era to the latter part of the 8th century after it, when it finally became choked up and useless. Napoleon I, when in Egypt, had thoughts of making a great ship canal across the isthmus; and from that time various schemes for accomplishing this were proposed. At last, about 1854, M. Ferdinand de Lesseps, a French engineer, obtained from the late Saïd Pasha, viceroy of Egypt, the concession or exclusive privilege of making a ship canal from Suez to Tineh on the Mediterranean; and after his plans had been weighed and debated for years he was able to form a company in 1858 for the purpose of carrying them out. Half the shares were taken in France, one-fourth in Egypt and very few in England, mainly owing to Lord Palmerston's objections on political grounds and Robert Stephenson's on engineering considerations. After many compromises the following important conditions were agreed to: The land on both sides of the canal is to be retained by the company for 99 years. The quantity of this land is only to be sufficient for the purposes of the canal and for the various works at Port Saïd, Ismailia, and Suez; none of it is to be sold to other parties. All persons residing upon the conceded land are to be subject to the same local and consular jurisdiction as residents in other parts of Egypt. Some of the privileges originally granted to the company by the viceroy of Egypt were bought back by him at very high prices; some others he was unable to fulfil and paid a corresponding compensation by remitting certain demands which he would have been otherwise entitled to make. In these and in other ways the viceroy became largely interested in the scheme. In November 1875 the British government bought from the viceroy his interest in the canal, consisting of 176,602 shares, for $20,000,000.

The work was begun on 25 April 1859 and it was estimated that the canal would be wholly completed in 1864, at a cost of $30,000,000. It was opened only on 17 Nov. 1869, and the total cost was about $80,000,000. Large numbers of men were of course required for the works, and crowds of Fellahin, Arabs, Nubians, Negroes, Sicilians, Greeks, etc., were engaged upon them, while dredges and other machines of great power were also employed. To facilitate the construction of the great canal a service canal 20 feet wide and five deep was constructed for part of the distance, by which men and materials could easily be conveyed. A canal was also constructed for bringing fresh water from the Nile at Bulak near Cairo, since without an extensive supply of this necessity of life the canal works could not have been carried on in the waterless region of the isthmus. This canal reaches the salt-water canal at Ismailia, about midway between the Mediterranean and the Red Sea, and then runs almost parallel to the course of the ship-canal till it arrives at Suez. Previously existing canal works were partly available for the fresh-water canal. It has proved a boon to the country all along its banks. It is about 40 feet wide and 9 deep, and is used for navigation as well as for domestic purposes and irrigation. From Ismailia to Port Saïd fresh water from this canal is conveyed through large pipes. Plugs are inserted in the pipe along the route where necessary to allow the withdrawal of water for domestic or other purposes. The great canal itself differs in dimensions in different places, being narrowest where the amount of cutting was greatest. For about four-fifths of its length (77 miles) it was at first 327 feet wide at the surface, 72 at the bottom and 26 deep; for the remainder (22 miles) it was only 196 feet wide at the surface, the other dimensions being the same. Many portions of the canal were easily enough made, but at other points the excavation demanded an immense amount of labor. In one place the workmen had to cut a passage 90 feet deep and 200 wide through sandstone rock. Port Saïd was chosen as the Mediterranean entrance of the canal instead of Tineh, because here the deep water is nearer the shore. It has grown up since the works commenced, and possesses basins, quays, a lofty lighthouse with electric light, etc., and a harbor protected by two breakwaters or piers, the one 2,070 yards long, the other 2,730. Leaving Port Saïd the canal first passes for about 24 miles along the eastern margin of Lake Menzaleh, an extensive and very shallow lagoon. The water of the lake is not admitted into the canal, which is confined between embankments, and is from 26 to 29 feet deep — much deeper than the lake. Beyond Lake Menzaleh occurs a sandy strip of three or four miles, after which the canal enters Lake Ballah, where embanking and dredging had again to be resorted to; passing through this for about eight miles it next runs through a land portion of the same length, in which occurs the formidable cutting mentioned above, and it then reaches Lake Timsah, about half way across the isthmus. This is a small lake, and had long been dry, but is now filled with sea-water, and abounds with fish. Lake Timsah is a stopping place for vessels passing through the canal, and affords a large space suitable for anchoring. Between Port Saïd and Lake Timsah the canal is nearly straight, and between the former place and Lake Ballah quite so; the southern half of its course is more winding. On the western shore of Lake Timsah is situated the town of Ismailia, which owes its existence entirely to the canal and the railway which connects it with Zagazig, Cairo and Alexandria. At Ismailia the fresh-water canal is connected with the great canal by means of locks, their levels being different. In the nine miles through which the great canal is carried after leaving Lake Timsah enormous quantities of rock had to be removed; then come the Bitter Lakes, like Lake Timsah formerly dried up, but now filled with sea-water; then a length of 17 miles, partly through a shallow lake, partly through a sandy desert, after which the canal reaches its terminus at Suez. Extensive works have been constructed here, among which are a mole 850 yards long; a dry dock, 413 feet by 95, built by the Khedive of Egypt; another, 360 feet by 85, for the Peninsular and Oriental Company, etc.

The shipping passing through the canal has steadily increased since its opening. In 1870, 486 vessels, of a total burden of 654,915 tons, sailed through it, yielding the company an income of $1,032,000; in 1874, 1,264 vessels of 1,649,188 tons passed through and the receipts amounted to over $5,000,000. In 1913, 4,979 ships of a total tonnage of 19,785,040 passed through the canal, the passengers on these ships numbering 282,235. In 1918, 2,522 vessels of 9,251,601 net tons passed through the canal. The following table covers the ships of those nations chiefly represented in 1913:

NATIONALITY	Number	Tonnage
British	2,902	11,887,170
German	771	3,317,593
Dutch	338	1,283,986
French	255	925,709
Austro-Hungarian	244	840,068

The tolls charged were nine francs per ton for laden passenger or cargo steamers and warships; six and one-half francs per ton for ships in ballast without passengers and 10 francs for each passenger. Successive reductions in the tolls in 1911, 1912 and 1913 have made the charges equal to the rates proposed for the Panama Canal. (See PANAMA CANAL). The fact that Britain was miserably represented on the board of management in course of time created much dissatisfaction among British shipowners, and in 1883 there was much talk about the construction of a second canal. This came to nothing, but led to the widening and deepening of the existing canal and the construction of large basins to allow north and south-going vessels to pass each other. The depth is now (since 1913) 36 feet, accommodating vessels of 31½ feet draught. An electric lighting system has also been installed which permits of navigation being carried on at night. The distance between London and Bombay by the old route round the Cape is about 11,220 miles; by the new route opened up by the canal 6,332 miles. Steamships are allowed to sail at a speed of five to six knots an hour along the canal. Consult 'Statesmans' Year Book.' See CANALS.

SUFFERN, N. Y., village of Rockland County, on the Erie Railroad, 32 miles north by west of New York. It has iron works, foundry, etc. Pop. 2,663.

SUFFIELD, Conn., town in Suffield township, Hartford County, on the New York, New Haven and Hartford Railroad. It is 16 miles north of Hartford and has chiefly tobacco and cigars as its manufactures. Pop. 3,841.

SUFFOLK, sŭf'ŏk, Va., town and county-seat of Nansemond County, on the Nansemond River, and on the Atlantic Coast Line, the Southern, the Seaboard Air Line, the Norfolk and Western, the Norfolk and Southern and the Virginian railroads, about 20 miles southwest of Norfolk. It is in an agricultural region. The chief manufacturing industries are woolen mills, lime kilns, lumber mills, iron works, grist mills, peanut factories, machine shops and truck package plants. Large quantities of oysters are shipped during the season. According to the government census, there are in Suffolk 100 manufacturing establishments, with over $2,000,000 capital invested and employing over 3,000 persons. The cost of material used annually amounts to more than $1,060,000. There are three banks with a combined capital of $210,000. The educational institutions are the public schools. Pop. 7,008.

SUFFOLK (Va.), **Operations Around and Siege of.** Soon after the occupation of Norfolk and Portsmouth by the Union troops, 10 May 1862, a force was pushed out to occupy Suffolk, 25 miles southwest of Portsmouth by the Seaboard and Roanoke Railroad, and at the head of Nansemond River, by which it had communication with the mouth of James River, and also Petersburg and Richmond by the Norfolk and Petersburg Railroad. It was not only an important outpost to Portsmouth, and the key to the mouth of James River, but also the key to all operations in the region bordering on the Nansemond and the Dismal Swamp, and was a favorable point for operations against the Weldon and Petersburg Railroad. The Confederates began active measures to reoccupy the place. Late in August it was held by General Mansfield with about 6,000 men and six guns. About half of the garrison was withdrawn early in September and sent to the Army of the Potomac, and with them went Mansfield. Taking advantage of the reduction of the garrison, the Confederates began preparations to attack the place, and on 22 September Gen. J. J. Peck was placed in command, with 9,000 men, under orders to repel the advance from the Blackwater of a reported column of 15,000 Confederates, under Generals French and Pettigrew. On the 25th Peck began the construction of a system of defenses, encircling and covering the place, which, by the end of January 1863, mounted 60 heavy guns. Early in January 1863 the Confederate authorities came to the conclusion that Peck was preparing a base of operations for a grand movement on Petersburg and Richmond, in co-operation with the Army of the Potomac, and began the construction of a series of works from the line of the Blackwater to Fort Powhatan, on James River.

General Peck was a vigilant officer, and made frequent reconnaissances of the Confederate positions along the line of the Blackwater, bringing on several collisions at Franklin, Zuni and other points, during the months of October, November and December 1862. Late in January 1863 General Pryor, who for some time had commanded a Confederate brigade on the Blackwater, crossed to the east side of that stream on a foraging expedition. He had three Virginia regiments of about 1,800 men and seven guns. On 30 January Gen. M. Corcoran, with a regiment of cavalry, five of infantry and 12 guns, in all about 4,800 men, started from Suffolk at 1 A.M., and at 3.30 A.M. the cavalry came upon Pryor's camp at Kelly's store, nine miles west of Suffolk. Artillery was run forward and engaged that of the Confederates for nearly three hours, when the infantry advanced, and after a short contest Pryor fell back two miles to a strong position, from which he was forced and pursued as far as Carrsville. Corcoran returned to Suffolk the same night, with a loss of 23 killed, 108 wounded and 12 missing; Pryor's loss was 8 killed and 31 wounded.

General Lee, informed that Union troops were being sent down the Potomac with the evident intention of operating against Richmond by the south side of James River, on 18 February ordered General Longstreet, with two divisions of his corps, to Petersburg and placed him in command of all Confederate troops south of James River, including those in North Carolina, to defend Petersburg and Richmond. Late in February Longstreet had, not including those in North Carolina, about 24,000 men, 12,000 of whom were on the line of the Blackwater, and 12,000 near the railroad to Petersburg, so posted that within 24 hours he could concentrate them all near Suffolk. It was left entirely to his discretion whether he should assume the offensive, but he saw the importance of confining Peck at Suffolk, and of collecting all the subsistence in that section of the country and getting it inside the Confederate lines, and Longstreet began a very thorough system of foraging. He employed the month of March in constructing elaborate defenses on the Blackwater, in assisting Gen. D. H. Hill in his operations against Newbern, Washington and Plymouth, N. C. (qq.v.), and in gathering all the forage and subsistence possible, under Lee's orders «to draw from the invaded districts every pound of provision and forage.» He reported to Lee on the 30th that there was no particular advantage in giving battle at Suffolk, nor was it prudent to make the attempt, unless he could get assistance from the navy in protecting his left on James River and the Nansemond. On 4 April he advised Lee of his intention to cross the Blackwater in a few days to get what supplies there were east of the stream, and, if he found it possible, to make an effort to get the Suffolk garrison. He crossed the Blackwater by pontoon-bridges on the 10th, and on the 11th, in three columns of nearly 20,000 men, advanced on Suffolk, capturing some of the Union outposts on the way, halting only when he came under artillery fire from the advanced works of the Suffolk defenses. Peck was fully prepared; he had been watching for the movement, and 14 March had been reinforced by General Getty's division of the Ninth corps, raising his command to 15,000 men. Admiral Lee, at Fort Monroe, was asked by telegraph to send gunboats up the Nansemond to prevent Longstreet from passing that stream and thus getting to the rear of Suffolk and the railroad to Portsmouth. Lee promptly responded by sending two flotillas of tugs (by courtesy called gunboats) to hold the river, one of eight boats, under Lieutenant Lamson, to hold the upper Nansemond, and one of four, under Lieut. W. B. Cushing, to hold the lower Nansemond. Longstreet's first move was to control and blockade the upper Nansemond, a narrow, tortuous stream, about seven miles long. For this purpose batteries were erected under cover of darkness, and on the morning of 14 April they opened fire on Lamson's boats, disabling one, seriously injuring others, and driving all into the lower Nansemond. In the afternoon of the 19th Lamson opened a heavy fire upon Stribling's Virginia battery, which had been put in an old work at Hill's Point, a tongue of land just above the junction of the Western Branch and Nansemond, and after a heavy cannonade one of his boats, carrying 270 men of the Eighth Connecticut and 89th New York, ran in shore and landed the men, Lamson following with four howitzers. They carried the work, capturing five guns, 55 gunners and 71 officers and men of the 44th Alabama. Next day the guns were carried across the river and the work abandoned. The erection of batteries gave Longstreet control of the upper Nansemond, but he made no effort to cross it, in the face of Getty's division on the eastern bank. He demonstrated on the lines west and southwest of Suffolk, but found no weak point in them, and did not consider an assault advisable, reporting to the Confederate Secretary of War 17 April: «I have not fired again at the enemy's stronghold, nor do I expect to do so. I am very well convinced that we could reduce it in two or three days, but doubt if we can afford to expend the powder and ball. To take it by assault would cost us 3,000 men. . . . The principal object of the expedition was to draw out supplies for our army. I shall confine myself to this unless I find a fair opportunity for something more.» On 29 April he wrote to Gen. D. H. Hill: «I am of the opinion that I can hold my position against any attack from the front. We shall be here two weeks longer hauling out supplies.» Hooker had now opened his Chancellorsville campaign, and on the 29th Longstreet, with his army, was ordered to return to Fredericksburg and join General Lee. It took him four days to call in his foraging trains and get them beyond the Blackwater. D. H. Hill was recalled from North Carolina, and on the night of 3 May Longstreet withdrew and recrossed the Blackwater, his rear-guard being closely pursued to that stream next day. The greatest number of troops Longstreet had before Suffolk was about 20,000. Peck had 30 April about 25,000. The loss of the Union army was 41 killed, 223 wounded and 2 missing. There was small loss in the navy. The Confederate loss is unknown. When it was definitely ascertained that Longstreet had withdrawn from the Blackwater, leaving only French's division of about 5,000 men to observe Peck, General Dix ordered Peck to take up all the rails on both railroads from the Blackwater to Suffolk and send them to Fort Monroe, and suggested to the authorities at Washington that Suffolk should be abandoned for a more defensible position on the line of Deep Creek, eight miles from Norfolk. The suggestion was approved, the position at Deep Creek fortified, the roads dismantled, under several attempts of French to prevent it, nearly 7,000 tons of railroad iron removed, the 100 heavy guns in the works around Suffolk withdrawn, the works leveled, and 3 July Suffolk, except as an outpost, evacuated. Consult 'Official Records' (Vol. XVIII, XXVII); 'Naval War Records' (Vol. VIII); The Century Company's 'Battles and Leaders of the Civil War' (Vol. IV).

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SUFFRAGE. See Aliens; Electoral Qualifications; Woman Suffrage; Elections; Naturalization; Vote, Voters, Voting; United States — Suffrage in the.

SUFFRAGE IN THE UNITED STATES. See United States, Suffrage in the; Woman Suffrage.

SUFFREN DE SAINT-TROPEZ, sŭ-frăṅ dè săṅ trō-pā, **Pierre André de,** French naval officer: b. Saint-Cannat, 17 July 1726; d. Paris, 8 Dec. 1788. He entered the navy at 14. In 1772 he was commissioned captain. Early in 1777 he sailed to America, and his ship began the indecisive battle of Grenada on 6 July 1779. He next served with the allied fleet blockading Gibraltar, and early in 1781 was placed in command of a squadron of five ships for service in the East Indies. Sailing to Madras, he fought a hard but indecisive battle off Madras, and soon after, in a bloody two-days' battle off Providien on the coast of Ceylon, proved himself a consummate master of naval tactics. Having captured Trincomalee, he two days later stood out of the harbor with 15 ships against the English 12, and fought a hard but indecisive battle. His last fight (June 1783) was also indecisive. Suffren arrived in Paris early in 1784, and was received with the greatest honors, and created Vice-Admiral of France. He was called also the Baillie de

Suffren, an office he held in the Knights of Malta.

SUFISM, soo'fĭzm or sō'fĭzm (Arab. *Tasawwuf,* being or becoming a Sufi), is Mohammedan mysticism. It derives its name from the Arabic *sufi,* mystic, «clad in wool» (from *suf,* wool), because most of these mystics clad themselves in woolen garments or carry a woolen headdress. Some philologists connect the word with the Greek σόφος «wise,» but their theory is untenable. Sufis often call themselves *urafa,* «Gnostics» or «Theosophists,» namely, those who possess a special and esoteric knowledge of divinity. Travelers of to-day in Persia, Egypt, India and Turkey commonly call them fakirs or dervishes (Arab *faqir;* Pers. *darvish*), that is, «the poor,» «beggars,» and the name is correct both in a good and a bad sense with this proviso that not all beggars are fakirs or dervishes.

The origin of Sufism is disputed. Some will derive it from the Vedanta and Buddhism, but their theories have no real foundations and fall to the ground when it is remembered that Vedanta is pantheistic and that Sufism in the main follows the Theistic lines of the Koran. Some even refer to it as an offshoot of Christianity. Sufis themselves reckon it to be older than its known historic forms and it seems quite probable that there was Sufism before the Sufis. As early as the 2d century after the Flight, asceticism and ethics and with them Sufistic quietism and the disinterested love of God, assumed a prominent position in Islam, and as fate would have it, contrary to Mohammed's explicit order, this new feature arose in his own family with the favorite Ali. The name seems first to have been used by Abu Hashim (780 A.D.); but Abul Said Chair is mentioned as founder (about 820 A.D.). Legendary lore, which has surrounded the pious woman Rabia al Adawiyya (725 A. D.) with much Sufistic halo, calls her the first Sufi and tells numerous stories about her quietistic disposition, all of which are profoundly characteristic of early Sufism.

Early Sufis are profuse in their expressions about their «Union with the Beloved» (namely, God), and that has probably led some Western scholars to confound the mystic union with the pantheistic *tat tvam asi,* «That (the Universal Spirit) art Thou.» Most Sufis of to-day are very moderate in their claims compared with their early predecessors, and declare that they are simply esoteric Mohammedans and place more value upon the «inner doctrine,» which they see behind the external forms, than upon the direct Koranic word. The inner meaning or doctrine which they read in such a verse as the following, which refers to the battle at Bedr, «Thou didst not shoot when thou didst shoot, but Allah shot,» minimizes individualism and makes the deity «all there is,» but in no wise All.

Essentially, Sufism is an inner and personal experience or feeling of God. In this respect it is as original as any other mysticism, but in its outward forms it has borrowed, like any other mysticism, from its environment. Its immediate cast is Mohammedan, but its speculative and doctrinal forms are in the main drawn from Parseeism, Peripatetic Philosophy and Neo-Platonism. From the first it draws a large part of its rich symbolism. The two latter were brought to it by the seven Greek philosophers whom Justinian's intolerance drove into exile and who found a welcome refuge at the court of Nushirwan, the Sassanian king. Sufis do not like to admit this, but it is a fact.

Sufism is primarily not a doctrine, but an experience, a «feeling.» When it expresses itself intellectually it finds outlet in two principal doctrines, that of the *One* (Ahad) and the *Way to the One* (Tariqat). The first declares that there is not only «no god but God,» but that there is nothing but God, a teaching which excludes all pantheism, inasmuch as it never says that the All is God, only that God is the All, and emphasizes that the world is a phantom, an unreality. The second doctrine: «The Way to the One» contains the whole of the Sufis' ethics and is practically the main burden of all Sufi conversation. There are many methods or «Ways» (Tariqat) to «Union with God.» They say «The Ways unto God are as the number of souls of men»; but they all begin with ascetic practices and end in a contemplative beholding of the Divine.

Most of them include the well-known Dervish dances, absolute silence for several years, and other occult practices.

Sufism is rich in symbolism and some of it is familiar to readers of Hafiz and other Persian Sufi poets. A symbol is to a Sufi rather more than an emblem or a figure of speech; it is what he calls a «veil,» that through and by its material form reveals the Deity. When Hafiz and Omar Khayyam in true Sufi fashion glory in wine, for instance, they do not glorify intoxication in any other sense than that in which it was used about Spinoza, namely, that he was full of God — a «God-intoxicated man.» Wine is to them a form or manifestation of God, as it is in the sacrament to the Christian. When they sing its praises, their song is a hymn and spiritually they partake in a mystery. A Sufi is not a drunkard nor a licentious man. The «wine and women» of the reveler has no place in asceticism and the inner life. That Sufi poets should use such strange language has always been a mystery to the uninitiated, who likes to read the Sufi's language literally and believe what he says literally.

Sufis lay more weight upon the conception of God as the «Eternal Beauty» than most religious and mystics. God creates because he is beauty, it being the essential nature of beauty to reveal itself. The act of creation consisted in God throwing His reflection on «the mirror of not-being,» and creation itself is thus only a reflection, a contingent being.

Man is the eye of creation, the point through which the Divine looks out and the one who, if he loves wisdom, goodness and beauty, can overlap his individual limitations and attain «Union with God,» the goal of Sufism.

In addition to the already mentioned famous Sufis are to be reckoned Dhun-Nun (859 A.D.), who formulated the doctrine of ecstacy and prepared a scale of mystic steps; Junaid (910 A.D.), who wrote about Sufism; Al-Ghazzali (411 A.D.), and Jallal-ud-Din Rumi (1262 A.D.), the two most famous Doctors of Sufism. Omar Khayyam is now known in the West mainly in the negative light of Fitzgerald's paraphrase and by (thus far) the only Sufi interpretation by the writer of this article. Almost all the famous Persian poets were Sufis, namely, Attar, Anvari, Nizami, Hafiz, Saadi, Jami, etc.

A Sufi Publishing Society, Ltd., has been established in London by Inayat Whan in 1915. He is of the Chistee Order and is the Pir-O Murshid of the order in the West. Sufism is also being preached in America, but has as yet no recognized headquarters and director.

A large number of the Ottoman poets are also Sufis. Consult following Sufi works: Jalal-ud Din Rumi, 'Mathnawa'; Attar, 'Mantigat-Tair'; Shabistari, 'Gulsan-i-Raz'; Al-Ghazzali, 'Alchemy of Happiness'; 'The Divan of Shamsi Tabriz'; Tholuck, 'Sufimus'; Palmer, E., 'Oriental Mysticism'; Gibb, 'History of Ottoman Poetry'; Browne, E. G., 'Literary History of Persia'; Nicholson, J. A., Selected Poems from the 'Divan-i-Shams-i-Tabriz' and Nicholson, Reynold A., 'The Mystics of Islam.'

C. H. A. Bjerregaard.

SUGAR ACT. See Acts of Trade.

SUGAR BEET. See Beet; Beet-sugar.

SUGAR-BIRD, one of the small, insectivorous honey-creepers (genus *Certhiola*) of the West Indies (except Cuba). Some species of which are called banana-quits, quit-quits, etc., which come about the grinding mills and warehouses where sugar is kept, attracted by the multitude of insects there. These little birds, on account of their familiarity and their pretty plumage, are favorites and often enter dwelling-houses, where they hop gravely about the furniture and explore the room after spiders and other prey which the housekeeper will willingly part with. In their figure and motions they remind a Northern naturalist of a nuthatch, while their coloration — black, yellow, olive, gray and white — recalls to him a titmouse. They generally keep in pairs and build a rather rude domed nest, which finally holds three red-specked eggs. There are many species, several of which are peculiar to single islands. Consult Gosse, 'Birds of Jamaica', and Cory, 'Birds of the West Indies.'

SUGAR GROWING AND SUGAR MAKING. Sugar (French, *sucre;* German, *zucker;* Spanish, *azucar*) is a substance of the formula ($C_{12}H_{22}O_{11}$. There are other substances, lactose, maltose, etc., of this formula and of the formula $C_6H_{12}O_6$, that are termed sugars, but they differ in their characteristic properties from cane sugar or sucrose, which is sweeter and more pleasant to the taste than any other natural saccharine substance, unless it be levulose ($C_6H_{12}O_6$) which is formed by the inversion of sucrose. Levulose is a constituent of honey, the fine flavor of which is due largely to this sugar. It will be seen from the sucrose formula that sugar is composed of carbon, hydrogen and oxygen and the two last in proportion to form water, hence the term carbo-hydrate applied to it and many other similarly constituted bodies, such as starch ($C_6H_{10}O_5$) and dextrose or grape sugar ($C_6H_{12}O_6$). The theory of the formation of sugar as well as that of some other similar bodies, is that carbon dioxide combines with water to form a substance, formaldehyde, of the simple formula CH_2O. This then becomes the nucleus of the sugars and carbo-hydrates and possesses the property of polymerization (uniting with itself to form a larger molecule of similar percentage composition) by which they are built up. The term sugar, in its strictest sense, means cane sugar and while it occurs in many plants and flowers, its manufacture for commercial purposes is confined almost entirely to the sugarcane and the sugar-beet, though small quantities are made from a certain variety of the maple tree, from sorghum and from the date palm.

Cane Sugar.

Historical.— Although sugarcane (*Saccharum officinarum*) is now cultivated in all tropical and semi-tropical countries, its origin and that of its manufacture into sugar date back to the remotest antiquity and both remain somewhat in obscurity. However, the majority of evidence traces sugarcane to India as the home of its origin, though George Richardson Porter in his work entitled 'The Nature and Properties of Sugar Cane,' says, «The strongest proofs, carefully collected from the authorities of ancient and modern times, lead to the conclusion that China was the first country in which sugarcane was cultivated and its produce manufactured.» Another author (Prinsen Geerligs) states, «No real preparation is recorded before about 600 A.D., at which time a Chinese emperor sent a man to learn the art of sugar-making in India, for in the year 500 A.D., white sugar is mentioned as being shipped from India to Europe.» The views of Dr. H. W. Wiley and Prof. W. C. Stubbs agree with Prinsen Geerligs. In the 8th century sugarcane was extensively cultivated in the Nile delta and in this century the Arabs introduced it into Sicily and from there it was transported to Spain. It appears that the sugarcane was carried into Siam, Ceylon and Japan from China. A sugar trade existed between Syria and France in the 12th century. From France it was transported to Holland, from Holland to Italy and thence to Germany. Sugarcane was introduced into Santo Domingo soon after the discovery of America and from there it spread to Cuba and adjacent islands. It was introduced into Mexico in 1520, Brazil in 1532, Martinique in 1650 and Guadeloupe in 1644. It continued to spread through South America.

The manufacture of sugar up to this time was very crude. Inefficient mills operated by wind, water or oxen, were used for extraction; lime, clay and ashes as purifying agents; the evaporation was effected in open copper or iron pans placed directly over the fire and the refining consisted in melting, boiling and recrystalizing. These crude methods exist yet in some countries, especially in districts where cane is grown for making syrup and very crude sugar. Sugarcane was introduced into Louisiana from Santo Domingo by the Jesuits in 1751. Dubeuil built the first cane-mill and his efforts at manufacturing failed. The first refined sugar was made by Antonio Mendez in 1792, but the first refined sugar on a commercial scale was made in 1794 by Etienne De Boré. The plantations of these two planters now form a part of the city of New Orleans.

Varieties.— The variety of cane grown by them was called «Creole.» The principal present varieties, «stripped» and «purple,» were introduced in 1820 by Mr. Coiron, the first to use the steam-engine for extraction. He secured them from a planter in Savannah, Ga. These varieties are natives of Java and their introduction into this State gave a great impetus to the new industry. Dr. W. C. Stubbs, while director of the sugar experiment station of Louisiana, introduced two seedling canes known as D-74 and D-95, which have proved very superior to any varieties grown previously; the former is a green cane and better than the latter, which is purple. Since the success of Boré the industry has continued and reached its maximum yield, 710,827,438 pounds, in 1894-95, while other Southern States (chiefly Texas and Florida) the same year produced 18,565,123 pounds, making a total of about 325,621 long tons. Alabama, Mississippi and Georgia grow cane extensively, on a small scale, for the manufacture of syrup which is also produced in Louisiana, Florida and Texas.

Description.— Cane grows from 5 to 15 feet in height and from one to two inches in diameter. It is made up of short sections connected by nodes or knots, the spaces between the nodes being termed inter-nodes or joints. The nodes have on them a bud or eye and are made up largely of non-saccharine content, while the inter-nodes contain most of the sugar. With proper conditions of temperature, moisture and soil the eye swells, bursts and puts forth a young cane which emerges from the soil with one leaf (being endogenous) which is rolled and tapers to a sharp point. In a few days a leaf is observed, which gives place to a bud. As the plant grows leaves are formed on alternate sides of the nodes and below the eyes. The leaves grow to a length of about three feet, two inches wide at the base and taper gracefully to a point. When only a few weeks old, the plant will begin to exhibit nodes and internodes, which are at first green. As the plant matures some continue green, while others become purple, striped, yellowish-green, etc., the color depending on the variety, of which there are a great many. As the cane matures the first leaves (those at the bottom) turn yellow, lose vitality, dry up and fall off, leaving the lower portion of the stalk bare while the upper portion continues green, succulent and growing until killed by frost or arrested by maturity, when it flowers and seeds. It is only in tropical countries that cane flowers and the time required for this is from 12 to 15 months.

Propagation.— Sugarcane is a perennial plant and can be propagated by layers or cuttings, or seed, the former being generally practised, the latter to cross-fertilize and produce new varieties. The entire cane may be planted, but the upper portion is thought best for seed. In many countries this portion is used for seed, but in Louisiana and adjacent States the tops are thrown away except a small portion fed to stock during harvesting. The Louisiana planter claims that labor is too scarce at harvest time to take care of this part of the crop, which would, by taking off the partially-matured joints, be ample for seed. The cane is cut near the surface of the ground, leaving a stubble or "ratoon" which sprouts in the spring and is capable of producing a second and even a third crop in Louisiana, and in tropical countries 5 to 10 crops can be grown with but one planting, though the general practice, where cane and labor are abundant, is to plant annually or biennially. The tendency of the young canes is to sucker and a large portion of the crop may come from suckering, especially if the stand is poor. The crop from the plant cane is larger than that from stubble in Louisiana, but the reverse is true for two or three years in the tropics and each successive stubble crop is less than the preceding. The stubble cane is richer in sugar and has more fibre than plant cane and is not considered as good for seed as the latter.

Soil, Its Preparation; Cultivation.—Sugarcane is grown more or less in all tropical and semi-tropical climates and the soil in which it can be grown may be of very varying character. A suitable soil should be very fertile, capable of retaining a large amount of moisture and with enough clay in the sub-soil to prevent leaching of the soluble constituents, at the same time it should be well drained. Cane grows well in the Southern States (Georgia, Florida, Alabama, Mississippi, Louisiana and Texas) in both sandy loam and clay loam soil, but the alluvial soils of the valley lands are best adapted for growing cane. The preparation of the soil is a very important feature of cane culture. If the land should be at all stiff or very clayey, preparation should take place or begin in the fall. The lighter soils of a porous or loose character may be prepared just before planting. It is customary in this country in preparing the soil to throw it up in ridges, five to seven feet apart, and when this is done in late summer or in the fall with a large quantity of vegetable matter, whether of grasses or peavines, the soil is in fine condition for planting in early spring. In rotation of crops corn and peas usually follow cane.

Planting.— The planting of the cane consists in opening the ridges and putting the cane into a deep furrow and then covering with a plow, sometimes rolling after covering. One, two or three canes may be planted along side by side in Louisiana or other Southern States growing cane, but in the tropics short pieces may be planted. It is the custom of some to cut the cane in lengths of 18 to 24 inches before planting, while others cut it only where it is crooked, the object being to make it lie well in the furrow. Recent experiments in Hawaii have shown cutting to be of great value in securing a good stand. In some countries only the upper portion of the cane is planted, for reasons already given. The quantity required per acre varies from four to six tons, thus requiring a large investment in seed cane on a large plantation.

Preserving Seed.— The seed-cane is preserved through winter by windrowing or matting, the former being more generally practised. Windrowing consists in cutting and piling the cane in a continuous row between the ridges in such a manner that the tops and leaves cover up the butts of the cane, after which dirt is thrown over, sufficient to cover the cane or partially cover it. Matting differs from windrowing chiefly in having trash or grass thrown over the cane before it is covered. Cane thus preserved is not altogether protected from hard freezes nor from "dry-rot" in case of very dry weather.

Fertilization.— The fertilization of the cane is very important, as one fertilizer may tend to grow a heavy tonnage with small saccharine content, while another may grow less tonnage but proportionately more sugar. The fertility of the soil is maintained by the addition of commercial fertilizers, distributed either in drill or broadcast, by rotation of crops and by growing heavy crops of pea vines.

Cultivation.— The cultivation should begin as soon as the cane is well up and has for its object the destruction of weeds and grass and maintenance of good tilth. Frequent moving of the soil to a very shallow depth is advantageous, while deep plowing is very injurious. It is necessary to hoe the cane from one to three times. The cane is usually laid by in this country in the latter part of June or the first of July and the implement used for this final work is the disc plow which throws the soil well up around the roots of the cane, leaving it on a high ridge, the chief purpose of which is to aid in drainage.

Drainage.— The drainage of the valley lands in Louisiana is very important and expensive. The land is cut into small pieces varying from two to five acres, with a system of mains and laterals to take off the excess of water.

Irrigation.— Irrigation should be practised, if possible. This is essential in some of the islands of Hawaii. The water is applied by allowing it to run in the furrows. Irrigation is practised very little in Louisiana.

Harvesting.— Cane has about eight months to produce sugar in this country, while in Hawaii, Cuba and other tropical countries its growth may extend over one year or 18 months before being harvested. The harvesting period in this country is from October to January, in those, from January to mid-summer. Cane is usually cut by hand, though cane-cutting machines have been in operation of recent years, These, however, have not been perfectly satisfactory. The instrument used for cutting cane is a large steel knife, with a blade about five inches wide, 18 long and provided with a little hook on the back. The cane is cut at or near the surface of the ground, the leaves stripped off with the hook, the top cut off at the last matured joint and the cane put into piles along the rows. From here it is taken up, either by hand or machinery, put into carts and laid across large ropes, or put into cars, and transported to the factory. Here the cane is taken out by hand or machinery and if the latter, it is accomplished by a derrick which lifts the entire load by means of the rope on which the cane has been laid. These large bundles are piled up around the factory and when the cane is to be crushed, it is taken up by the same machine, elevated to an incline, dropped on it and slides down to the cane carrier and thence to the mill.

Extraction.— There are in practice two methods of extracting the sugar from cane, namely, milling and diffusion. The older and more generally used is milling, the diffusion being confined almost entirely to manufacture of sugar from beets. A mill may consist of two or three rollers, usually placed horizontally, and vary in length from 18 inches to 72 inches, and in diameter from 12 to 32 inches. If the mill is to be operated by oxen or by horses the rollers are set in an upright position. The most primitive mill was the wooden roller. This has been used in a small way in some of the Southern States since the Civil War, but there is at this writing, perhaps, not one in existence in this country. In most large factories there are two of these three-roller mills and in some, three. The rollers are so arranged that two are placed on a level and geared to move in the same direction while the third moves in the opposite direction. If a factory operates two mills the rollers of the first are further apart than those of the second, and if three mills, the third has its rollers closer together than the second. These rollers revolve very slowly (one and one-half to two and one-half revolutions per minute) and are operated under great hydraulic pressure. To relieve the strain upon the mill, a cane crusher or shredder has come into general use. The cane enters one of these as it leaves the cane carrier and is either crushed or shredded into small pieces before reaching the mill. This not only relieves the mill of the work of crushing the whole cane, but increases its capacity. The capacity of mills will vary from 200 to 1,400 tons of cane per day and the extraction is 70 to 80 per cent on the weight of cane and 90 to 95 per cent of the sugar in the cane. Between the first and second mill the juice receives a spray, through a perforated pipe, of either hot or cold water, the object being to dilute the sugar so a larger percentage will be crushed out by the second mill. This addition of water is termed maceration and the quantity of water added may vary from 5 to 15 per cent of the weight of the cane and in some cases as much as 20 per cent, the quantity depending somewhat upon the value of fuel and the capacity of the evaporating outfit. In some instances the diluted juice from the third mill is returned and used for macerating the crushed cane between the first and second mill, and water is used between the second and third. The value of maceration may be seen from the following estimate taken from practice: It has been estimated that maceration increases the extraction from four to six pounds of sugar per ton of cane. A factory crushing 500 tons daily and operating for 90 days, would crush a total of 45,000 tons. An increase of five pounds per ton would yield to this factory 225,000 pounds of sugar. This quantity at 3.5 cents per pound (the price paid for 96 test last season in Louisiana) would amount to $7,825. Supposing that 10 per cent of water on weight of cane was used, then for every ton of cane there would have been 200 pounds of water or approximately 25 gallons. It is estimated that one pound of coal will evaporate about eight pounds or one gallon of water. Then the 25 gallons of water would require 25 pounds of coal. Coal being valued at $4 per ton or 20 cents per 100 pounds, 25 pounds would be worth five cents, this deducted from 17.5 cents, the value of five pounds of sugar, leaves 12.5 cents as the net value gained per ton of cane and the 45,000 tons would be worth $5,625.

Diffusion.— Extraction by diffusion is treated under beet sugar and it is necessary here to give only a brief statement with reference to diffusion as applied to sugarcane. Diffusion has been practised at several factories in Louisiana and some other countries, but it has not yet met with very great favor. The diffusion process in Louisiana has been abandoned. There are claimed for diffusion the advantages of a purer juice and a higher percentage of extraction. In a battery used for sugarcane, the juice will vary in sucrose from .3 per cent in the last of a series of 12 to 14 cells, to 16 per cent in one freshly filled. The disadvantages of this process are, large amount of water to evaporate, more skilled workmen required and the chips are not so good fuel even after running through a press, which causes additional expense.

The Utilization of Bagasse.— The cane after receiving its final crushing, whether passed through two or three mills, contains from 40 to 50 per cent of water and is, therefore, a poor fuel if its value be estimated on the weight of bagasse. If allowed to accumulate it would become a great nuisance about the factory, hence it is consumed as fuel. If the ash contains silica and alkalies in proportion to form a fusible mixture, a slag will result and choke the furnace by forming a coating over the gratings; for this reason the burning of a mixture of bagasse and molasses has not been satisfactory. Notwithstanding its high water content, it supplies about two-thirds of the fuel in the Louisiana sugar factory and practically all of it in the tropical countries where the percentage of fibre is from 2 to 3 per cent more than in this State. Six tons of wet bagasse or three of water-free, are said to be equivalent to one ton of ordinary bituminous coal. Experiments at a very great cost have been made to produce paper from bagasse at Sugar Land, Tex., and at Kenilworth Sugar Factory in Louisiana. Neither has been a commercial success, though there has been a considerable amount of rather an inferior grade of brown paper from these mills put on the market in this section. The Kenilworth mill cost about $300,000 and it is said that the running of it for one year added to this amount $50,000 to $60,000 more. This mill is shut down and the bagasse from the last crop was consumed as fuel. The manager of this mill claims that the percentage (about 30 per cent, according to his estimate) of paper-producing fibre is too small, that the color is poor and bleaching is too expensive and that the paper is wanting in strength. The opinion of the writer is that a fair test has not yet been made.

Clarification.— The juice as extracted by the mill has a gray or dark green color, an acid reaction, and contains sucrose, glucose or dextrose, perhaps a little levulose, gums, albumen, organic acid, pectine, the ash or mineral constituents, earthy and coloring matter, fine particles of suspended bagasse, etc. The following analyses show the composition of three samples of Java cane juice taken respectively from first, second and third mills in triple crushing:

MILL	Brix	Sucrose	Glucose	Ash	Gummy matter	Albumen	Acid	P	G. R.	Color
First........	19.2	16.49	1.98	.98	.125	.025	.048	88.90	12.1	light
Second......	19.3	16.33	1.57	.41	.376	.092	.072	84.40	9.6	dark
Third.......	19.0	15.95	1.57	.42	1.250	.025	.096	84.00	9.5	....

These results indicate the composition of cane juice in Java and other tropical countries where cane is grown under most favorable conditions. In Louisiana the juice has from 10 to 15 per cent sucrose, 1 to 2.5 per cent glucose or reducing sugars and the non-sugars vary from 1 to 3 per cent. There is usually a difference of 2 to 3 per cent sucrose and even more in some instances from the beginning, October, to the end, December and January, of the grinding season. The reducing and non-sugars also vary very much between the opening and close of the grinding. The purpose of clarification is to remove the impurities as far as possible. This is accomplished by chemicals and heat, causing the soluble impurities to become insoluble or solid. These are removed by settling or filtration. The principal chemicals are sulphur, lime and phosphoric acid. Sulphur is applied as sulphur dioxide which bleaches, disinfects, coagulates some of the albumen and prepares the juice for taking more lime, thereby causing a heavier precipitation which brings about a mechanical cleansing. Sulphur is not much used in the tropical countries where the juice is of a high degree of purity, but it is extensively used in Louisiana and other sections where the juice contains large portions of impurities. Lime is universally used and is the most important of all the chemicals employed in the sugar factory. It neutralizes acids, acts upon the gums, albuminous substances, coloring matters and, if added in excess, upon the glucose, converting it into organic acids. The lime compounds thus formed are largely insoluble, but some of them are soluble, the insoluble portion is removed by settling or filtration and much of the soluble can be got rid of by the addition of phosphoric acid to form the insoluble tri-calcium phosphate, or in some cases sodium carbonate, to form the almost insoluble calcium carbonate. Phosphoric acid is also used to correct any alkalinity resulting from excessive liming and sodium carbonate is very essential in properly correcting the acidity of sour juices. Lime salts, if left in solution in any considerable quantity, give trouble by depositing on the coils of the «effects» and «pans,» thereby reducing their efficiency in the evaporation. Carbon dioxide is used to correct alkalinity and remove excess of lime.

Defecation.— To carry out the process of clarification the juice as it leaves the mill is strained through a copper-wire gauze, then drawn into a sulphur box or tank, if sulphur be used, where it is thoroughly mixed with sulphur dioxide which is produced by the burning of sulphur in an appropriate oven nearby. From the sulphuring apparatus which may consist of a box in which the juice and «sulphur gas» are mixed by a pump or of a cylindrical rotating and inclined vessel in which the mixing takes place by rotation, the juice is drawn into measuring tanks of 2,000 to 6,000 gallons capacity. The clarifiers are rectangular or circular metallic pans, 700 to 1,200 gallons capacity, provided with a steam coil. These pans may be used also for measuring. In some cases the juice is heated before entering the clarifier, in others it is heated in them. Milk of lime, prepared by slaking and grinding, in especially constructed machines, is added in the clarifiers in sufficient quantity to neutralize, or leave slightly acid, or slightly alkaline, according to the practice of the factory, acid juices being worked to produce high-grade sugar and alkaline or neutral to produce low grades. The necessary quantity of lime required for a given quantity of juice is not easily determined. Several methods are in use for this purpose: (1) By the addition of lime until it shows a desired reaction with litmus or turmeric papers. (2) By testing a litre or gallon of the juice with milk of lime and applying the same proportion in the clarifier. (3) An approximate quantity is added, the juice heated, agitated, a small portion filtered and tested with sucrate of lime (prepared by shaking powdered lime with a 20 per cent sugar solution) which forms a precipitate if an insufficient quantity has been added. More lime is then added and the sucrate test repeated. This testing is repeated until the necessary quantity is obtained (Prinsen Geerligs). (4) The acidity of the juice is determined with a tenth normal caustic soda solution, using *phenolphthalein* as an indicator. An approximate but insufficient amount of lime according to the soda test is added, the juice heated, agitated, a small portion filtered and again tested with the soda. Now the exact quantity indicated by the soda may be put into the clarifier. On heating the limed juice a portion of the impurities rise to the surface, while others fall to the bottom. In some factories the settling takes place in the clarifiers, while in others the boiled juice is drawn off into large cylindrical tanks provided with conically-shaped bottoms, which facilitate settling. If the former method is used it is the practice of some to brush off the scum of impurities into a trough attached to the side of the clarifier and then allow other suspended particles to subside when the clear liquid is drawn off through a two-way cock and led into the evaporators or «effects.» When all of the clear juice has been drawn off and the mud begins to show up, the clear-juice cock is closed and the other one is opened and the residual juice with impurities is conducted to a receptacle provided for this quality of the liquid. The custom in other factories is to heat the limed juice nearly to boiling (about 95° C.), shut off the heat and allow to stand until the heavier particles of the precipitated matter collect at the bottom. The clear portion of the liquid is then separated as above stated. When settling is to take place in the settling tanks the juice is heated to boiling and at once drawn into these tanks. After complete settling the clear liquid is drawn off in a manner similar to that already described. It is the custom in some factories to filter through heavy canvas bags (one folded within another) the entire volume of juice, that is, the partially clarified juice, the muddy portion being conveyed to filter presses, arranged with cloths that fit in between cast-iron plates. The juice is pumped into the filter press where these cloths retain all the solid particles. The juice defecated and clarified as above described is sometimes defecated a second time, but in a very similar manner to that already described. This second defecation may take place immediately after filtration or in some instances it is after partial concentration or evaporation.

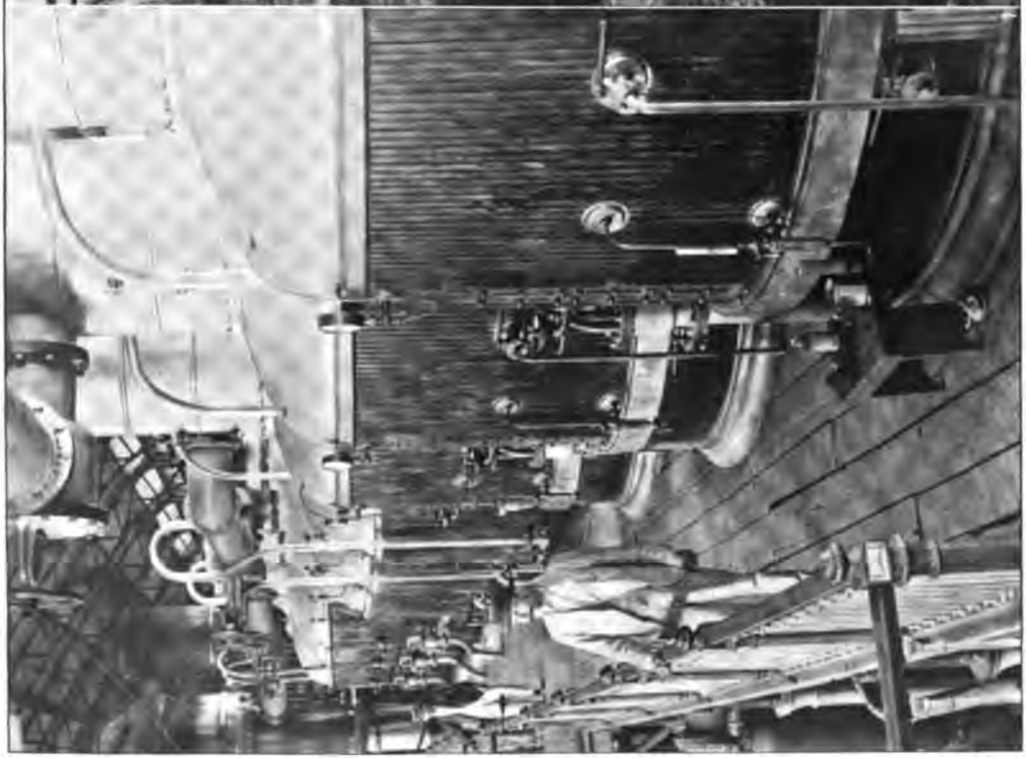
Carbonation.— See Beet Sugar.

Super-heating.— Of recent years there has been added to the ordinary defecating process a super-heating apparatus generally known by the name of the Deming Super-heater. It is claimed that the principle of the Deming system is in converting some of the soluble into insoluble material at a temperature of from 110° to 115° C. To apply this principle three vessels, cylindrical in form, are connected with each other by a system of tubes, two of these vessels being termed absorbers and the other digester. The juice enters one of the absorbers and is pumped through it into the second. In these it is heated by exhaust steam and passes thence into the digester where it is heated with live steam to the high temperature above mentioned. As it passes out from the digester it is surrounded by an inflow of the juice on its way to the absorbers which heats it up to about 50° C. The super-heated juice, limed before being heated, is conveyed to specially constructed settling tanks that permit of a continuous inflow and outflow of juice, the impurities being collected in the conical bottom of the settling tank. This tank carries within it a large cone, the top part of which is on a level with the top of the tank, the bottom part ending at the top of the conical portion of the tank. The cone, both ends of which are open, is suspended within the tank. The lower end of the cone is of a very large diameter while the upper end has a small diameter. The principle of this contrivance consists in a downward current of juice from its entrance into the tank and an upward flow through the cone, the particles of solid matter having a greater density than the liquid and to go downward, but the upward current causes a portion of them to rise, though in their ascent they strike the sides of the cone and are returned to the bottom.

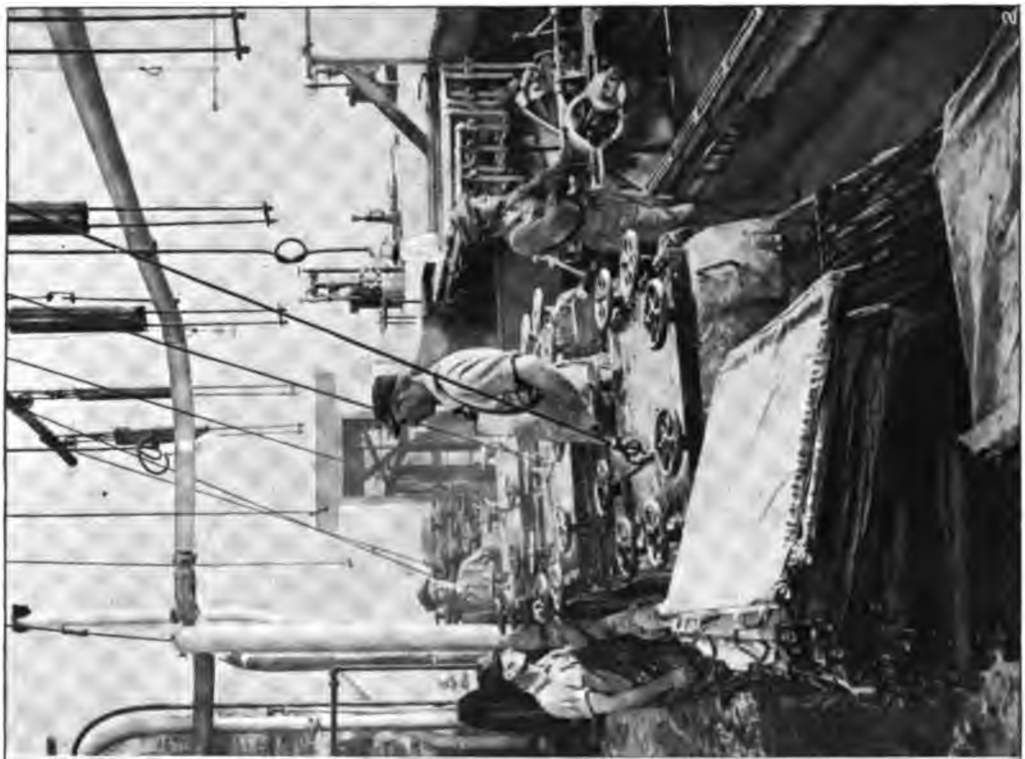
Evaporation and Crystallization.— The evaporation of sugar solutions or cane juice has for its object the concentration of the liquid to such a density as will cause the sugar to crystallize out. To accomplish this there are two methods, the «open kettle» and the vacuum pan. The open-kettle process consists in boiling the juices in open pans, either of circular or rectangular form, provided with steam coils. The heat is continued until the density indicates sufficient cooking. When a density of 22 to 36 Baumé is reached, the liquid is termed a syrup, and when the syrup is cooked to a stiff mass, a masse cuite. After allowing crystallization to take place in wood or iron vats, the masse cuite is thrown into a hogshead and the molasses percolates through a perforated bottom, or the sugar and molasses may be separated in a centrifugal machine. The sugar thus made is termed open kettle and the process is not used in the up-to-date factory.

The vacuum apparatus, a dome-shaped vessel, 5 to 10 feet in diameter, 8 to 15 feet high, provided with steam coils, is the most economical for evaporating sugar solutions, requiring only about one-third the fuel of the open kettle process and reducing to the minimum the

SUGAR INDUSTRY



1 Vacuum Vats, Sugar Mill, Cuba



2 Filtration Room, Sugar Mill, Nebraska

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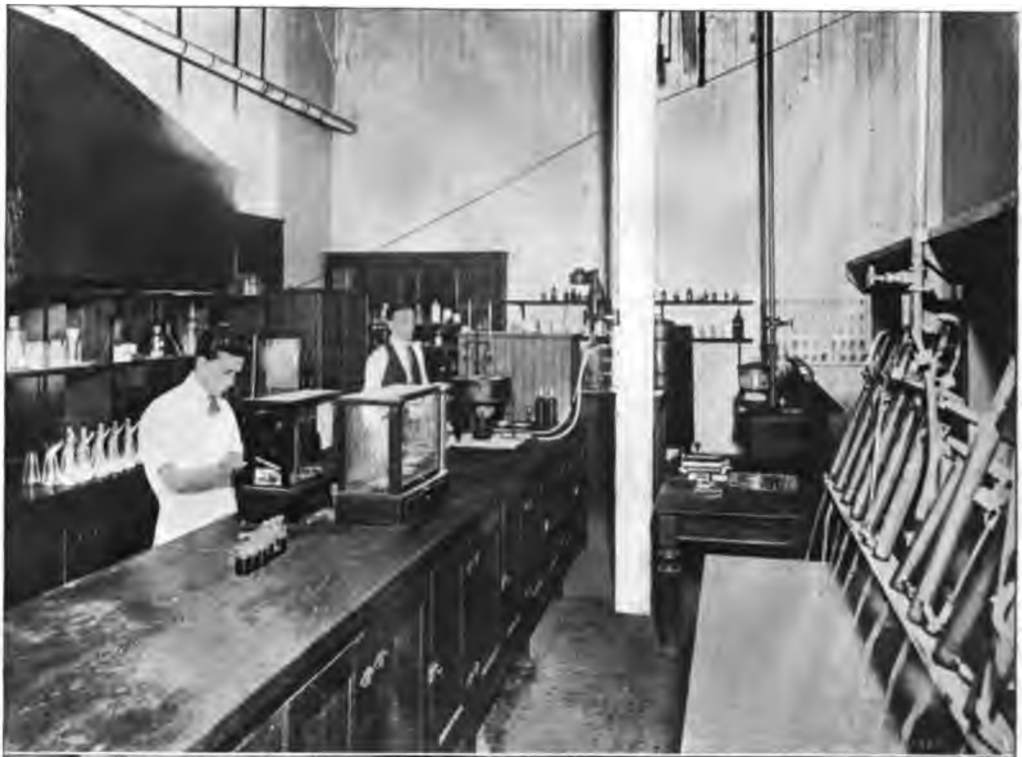
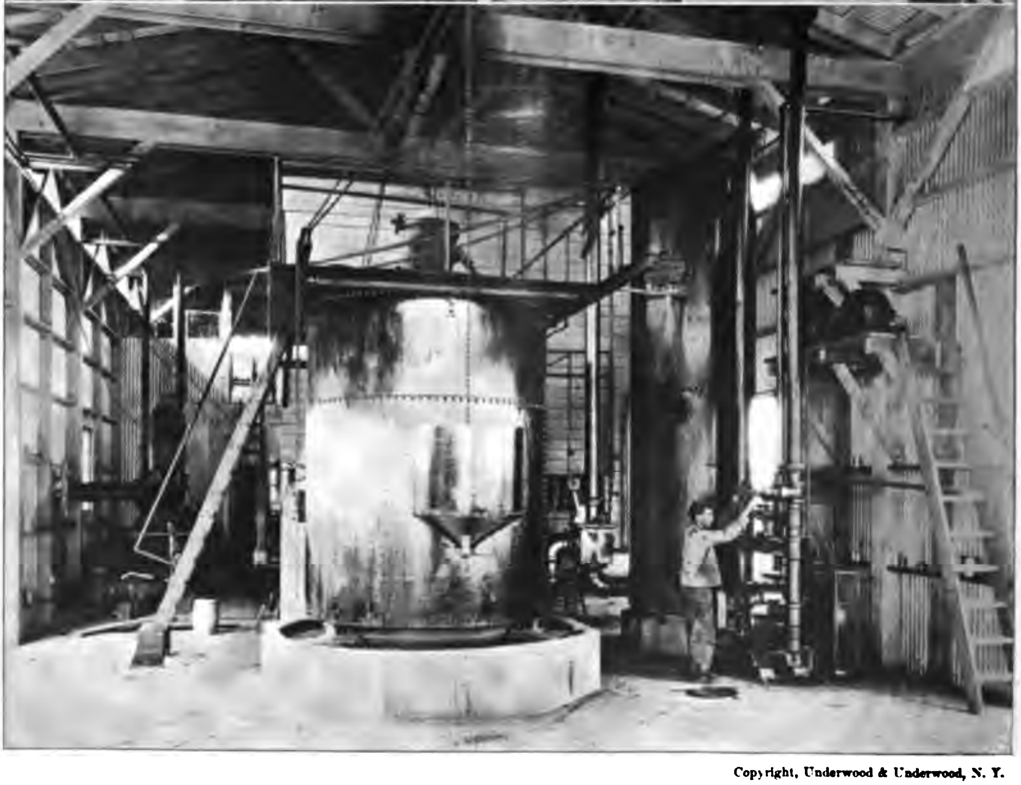
SUGAR INDUSTRY





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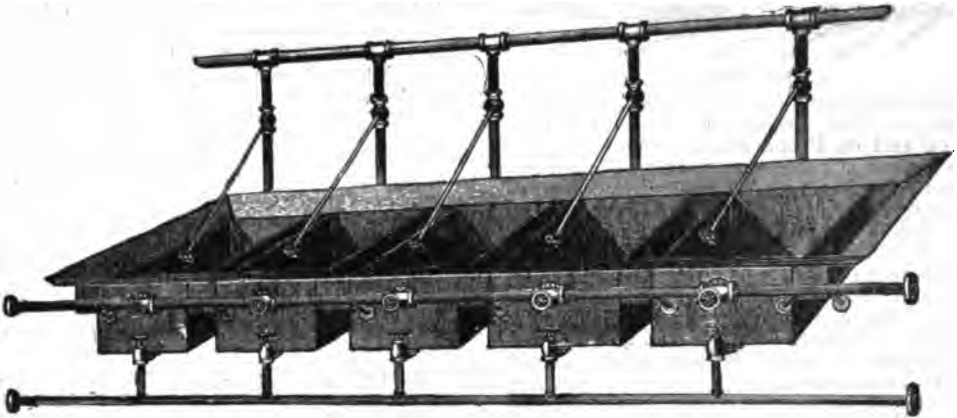
1 Chemical Laboratory, Molasses Factory, New Orleans

2 Gas Producing Plant, Molasses Factory, New Orleans

loss by burning or inversion. This apparatus may be arranged in «multiple effect» — two or more pans connected — or consist of one pan. More than three pans have not been found advantageous. These vessels are so controlled that the vacuum in the first is about 5, in the second 15 and in the third 25 to 27 inches, 30 representing a perfect vacuum. They are connected with a system of valves so that the juice may be drawn from the first to the second and from this to the third, from which it is drawn into a syrup tank. Exhaust steam is usually utilized for concentrating the juice, though it becomes necessary at times to use live steam. The steam enters the first and causes it to boil, and the steam generated in this is sufficient to boil the second and so on. The concentration is carried to a density of 22 to 26 Baumé or about 50 per cent water.

The syrup is drawn from the syrup tank into the vacuum strike pan until one, two or three coils are covered, and this definite quantity is heated until grains of sugar may be seen on withdrawing, with a proof stick, a sample and spreading it on a piece of glass. The formation of grain is sometimes brought about by permitting a little cold juice to enter the pan and suddenly cool it. The object here is to form a crop of «seed crystals,» and the remainder of the process has for its purpose the developing or growing to a desired size. This is accomplished by continuing the boiling and adding, from time to time, small quantities of the syrup, taking care that no more grains or crystals are formed. In three to four hours the pan will be as full as is convenient to cook it and the sugar crystals as large as desired. If very large crystals are wanted, as is sometimes the case with confectioners, a «cut» strike is made, that is, one-third or half the sugar in the pan is dropped out through the bottom and the remaining portion, say one-half, is built up in the same manner as already described. On completing the boiling the second time there are not so many crystals, but they are twice as large. This process may be repeated, but it is very expensive. The principle of the strike pan is similar to that of the effects already described. The vacuum in the pan is usually 25 to 28 inches and the temperature 140° to 160° F. The cooking is continued until the concentrated mass contains 6 to 8 per cent of water. The discharging of the pan is termed a «strike,» and the product discharged, «masse cuite.» This is conveyed to a mixer provided with a shaft carrying paddles or fingers that keep the sugar and adhering molasses mixed. The well-mixed masse cuite is next conveyed to a centrifugal machine, made to revolve 1,000 to 1,200 times per minute, and in its rapid motion the sugar and molasses are separated, the latter being thrown through very small perforations in a copper gauze basket, while the sugar remains in the basket. The product thus obtained is termed «first sugar,» also «raw sugar,» and usually of 96° test.



Clarifiers.

Beet Sugar.

Historical.— Sugar was discovered in the ordinary beet by Margraff, a member of the Berlin Academy of Science, in 1747, but the sugar content was very small, being from 2 per cent to 4 per cent. About half a century later, Karl Franz Archard undertook the extraction of sugar from the beet and his efforts were successful. Great interest in both Germany and France followed his investigation and by 1812 there were many factories established. Napoleon added greatly to the progress of this industry by government aid and by the establishment of sugar schools. After the new industry had become well established, it was almost obliterated by destructive wars. It was revived, however, soon in France and by 1829 a yield of 4,000 tons of sugar was made, but Germany's interest was not resumed until 1835. From these countries the industry has spread throughout Europe until the production for 1903 has been variously estimated at 5,000,000 to 6,500,000 long tons.

The first experiments with sugar-beets in the United States were made by two Philadelphians in 1830. About 10 years later David Lee Child, Northampton, Mass., attempted beet culture and the manufacture of beet sugar. He produced 1,300 pounds at a cost of 11 cents per pound. These enterprises failed and seem to have discouraged further efforts until Gennert Brothers, natives of Brunswick, Germany, inaugurated a plant at Chatsworth, Ill., in 1863, and this failed seven years later. Attempt after attempt failed and it may be said that this industry was not permanently established until between 1875–80. From this time sugar beet culture has been successfully conducted in the United States and at this writing there are 51 factories distributed over 13 States, with a production of about 208,790 long tons for 1905.

Filter Press.

Soil and its Preparation.— Sugar-beets require a mean summer temperature of about 70° F., and may, therefore, be grown in a very extensive territory in the United States, stretching from New York to California, but in this vast scope of country designated the sugar belt, there is much land that will not grow beets profitably because the soil is not adapted for such a purpose. While a great variety of soils may be suitable for growing beets, the soil best adapted for this purpose is a sandy loam with a sub-soil open so as to permit the beet to send down a tap-root and at the same time insure enough loose soil for the beets to grow well under ground, otherwise the tap-root will «sprangle» and the top of the beet will show above ground, both of which growths are deleterious to the best results.

In order that the beets may develop thoroughly, the soil must be of a loose, friable character and thoroughly prepared before planting the seed. The preparation is best effected by plowing about eight inches deep and following a sub-soiler to the depth of about seven inches and finally harrowing until all clods are broken and the soil thoroughly pulverized. If the land should be lumpy the young plants will find great difficulty in coming up, and it will be very troublesome to work or cultivate them. Thorough preparation usually destroys much weeds and grass that otherwise would interfere with the cultivation of the young beet.

Planting.— The beet seed are about the size of a small pea with a very small and rough exterior and should be put well under the earth but not deep. The seed are sown in ridges or furrows in the level ground, the latter being more general, from 14 to 18 inches apart. The seed are distributed with an implement termed a drill or seeder. The best time for planting is in the months of April and May. After planting a roller is pressed over the seed to press the soil close to them. If the rolling should make the surface too smooth and hard, another implement is passed over the ground to «roughen it up» because the wind sweeps over the fields and causes the sand to do damage to the young plants when the surface is without obstructions. Some plant seed in rows at right angles to the wind in order to avoid injury by it.

Thinning.—As soon as the young plants are well up or show four leaves thinning is begun. This consists of first bunching and then thinning to the proper number of plants to be cultivated for the crop. The thinning is performed by hand. The first part of the work is done with a hoe which leaves a clump of beet plants about eight or nine inches apart. The thinning to a stand is then completed by selecting the best looking plant from the bunch left by the hoe and this plant is protected by placing it between the fingers with the back of the hand down, and the remainder of the small beets are removed with a sudden pull. The thinning should be done before the beets grow tall enough to become entangled with each other.

Cultivation.— The cultivation of the beet is very expensive, inasmuch as a large portion of the work must be done by hand, though of late, improved agricultural implements have reduced the expenses. The beet should be worked in some way or other, if possible, every week, with a view of preserving good tilth, the chief object being to destroy weeds and grass and conserve the moisture by forming a loose layer of soil on the surface which closes the capillary tubes in the soil through which the water evaporates. Beets should be hoed two or three times, depending upon the weeds and grass. This hoeing is partly done by a plow, but the chief part of it must be done by hand. The cultivation period usually extends over six or seven months.

Harvesting.— The harvesting is begun in different sections of the country at different periods, depending upon the climatic conditions. In some portions of California harvesting may begin in August while in sections where the temperature is not so favorable it is begun in September and October. The harvesting extends from two to four months. The beets usually indicate when they are ripe by the leaves turning yellow and drooping to the ground. The first step taken in harvesting consists in running an implement down underneath the beets so as to cut the tap-root where it is small, and, at the same time, loosen the earth around the beet so it may be readily pulled up by hand. The beet is then taken up, by hand, and with a special knife the top or «neck,» as it is termed, is removed by one stroke. The top is cut off where the leaves begin to grow on the beet or just below this point. It has been found by experience that the top of the beet is very rich in non-sugars and that it is better to remove these to prevent their contamination in the process of manufacture. The beets are thrown in piles and, if they are to be sent to the factory immediately, they are not covered up, but where the beets are to be preserved some time they are put into piles of three to four feet in diameter and covered with a layer of earth varying in thickness from six to 24 inches. This latter process is termed siloing and the beets thus preserved remain in a silo until the factory is ready for them. The beets are taken to the factory in carts in which are placed nets, so arranged that they may be removed by machinery, carrying with them the entire load of beets, or the beets may be thrown directly into the cart and at the factory the cart is driven upon an elevated platform and the beets dumped out. The beets are next thrown into a large tank filled with water having a shaft, provided with fingers, so that during the process of washing the beets are kept continually agitated and brought near where fresh water is flowing into the tank. In this way all of the adhering soil is removed.

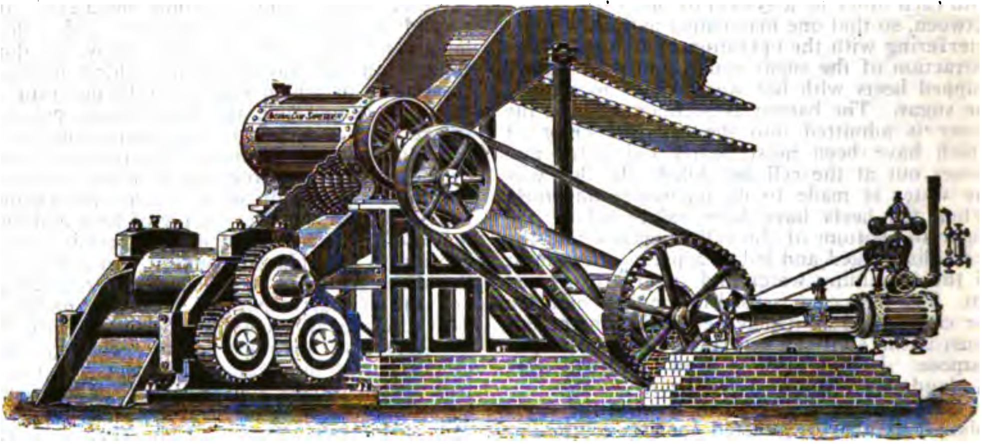
From the washing tanks the beets are taken by an elevator and carried above the diffusion battery and dropped into a slicing machine, where they are cut into very thin, narrow pieces so that when the chips fall they will not lie too compactly one upon the other. The chips are conveyed from the slicing machine to a hopper with a funnel-shaped tube and so arranged that it may be rotated or moved otherwise to fill the cells of a battery arranged in a circle or in «line.» The battery consists usually of from 12 to 14 cast-iron cylindrical cells connected with each other by a system of pipes with cocks between, so that one may empty and fill without interfering with the operation of the rest. The extraction of the sugar consists in washing the chipped beets with hot water so as to remove the sugar. The battery is so operated that the water is admitted into the cell, the chips of which have been most nearly exhausted and passes out at the cell last filled. In this way the water is made to do its maximum work. When the beets have been exhausted of the sugar the bottom of the cell is opened and the beets discharged and led to a press where most of the remaining water and sugar are pressed out. The pulp cake is used in the wet condition for cattle food or it may be dried with the exhaust steam so it can be preserved for the same purpose. It may also be used to spread over the land and serve as a fertilizer.

Carbonation.— The purification of the sugar solution as above extracted consists of the application of lime, carbon dioxide and sulphur, together with settling and filtering. The use of the lime followed by that of carbon dioxide is termed carbonation. These two materials, lime and carbon dioxide, are obtained by burning limestone in a kiln constructed for that purpose at the factory. The limestone is decomposed and the lime, mixed with water, is added to the sugar solution in a quantity equal to 2 or 3 per cent. The gas is led from the lime kiln through water to wash it and admitted into a large cell from five to six feet in diameter, with a capacity of from 4,000 to 6,000 gallons. These cells are provided with steam coils so the solution may be heated. The temperature at which the carbonation is carried on is 80° to 90° C. This process of adding lime, then charging with carbonic acid gas, is repeated two or three times, depending upon the quality of the juice, but after the first treatment the juice is filtered each time before repeating the carbonation. Finally the juice is treated with sulphur dioxide, which is used to bleach the solution, and then the excess of this gas or acid is removed by the addition of lime and the juice is again treated with carbonic acid. Before filtering the juice it is allowed to settle so that the impurities may collect at the bottom of the settling tank. The clear liquid is drawn off and filtered by gravity through bags. These bags are arranged in pairs, a large bag with a diameter of three or four feet is partially folded and put into one of thicker and stronger material, with a diameter of not more than 12 to 18 inches. When the bags become filled with impurities they are steamed and washed and made ready for another operation. That portion of the solution containing the bulk of impurities is also filtered through bags which are placed in a filter press and much of the liquid removed. The press cake is scattered over the field and used as a fertilizer. The clarified juice is treated the same as under *cane sugar*.

Molasses.— The molasses, containing 40 to 50 per cent of sugar, discharged by the centrifugal, must be treated for the sugar which it contains, though some of it in Louisiana is sold to merchants for direct consumption as table molasses, to confectioners and to glucose mixers for the preparation of glucose syrup. Generally, this molasses is recooked over and over again until all of the crystallizable sugar has been separated. The first reboiling yields «second sugar» and «second molasses,» the second reboiling «third sugar» and «third molasses,» etc. The reboiling may be done directly in the vacuum pan without previous treatment, in which case 5 to 10 per cent of water is evaporated, the boiled mass put into hot-room cars and kept at a temperature sufficient to maintain the masse cuite in rather loose or limpid state for from one to three weeks, or put into large cylindrical, slowly revolving drums provided with a proper supply of heat and kept in these for three to four days to permit crystallization to take place in motion. In either case the masse cuite is returned to the centrifugal and the crystals separated from the molasses. The practice at some factories is to mix the molasses with hot juice before reboiling, while others put it into eliminating pans, charge it with steam, dilute and reclarify. The second sugar may be sold to the refineries, but as it falls below the 96-test sugar (probably the most profitable grade) it is melted in the hot juice and turned out as first sugar of the test above mentioned. The second molasses is reboiled to «string proof,» put into large magma tanks or hot-room cars (about five by five feet and three to four feet deep) and allowed to remain at rest from four to six months, when the crystallized mass is subjected to centrifugaling. The third molasses usually contains a large portion of impurities which may make it unprofitable to further reboil it, though some work this molasses for fourth sugar. All the above grades of sugar recovered by reboiling may be worked back into a first sugar or sold to the refineries. The refuse or exhausted molasses, which amounts to from four to five gallons per ton of cane crushed and carries 25 to 40 per cent sugar, has increased very much in value in recent years, selling at 6 to 10 cents per gallon. Some of it is fed to stock and some consumed by distillers.

The molasses from the beet is worked over again and finally, in some factories, diluted, treated with powdered quicklime, which forms a sucrate of lime at low temperatures, and this sucrate is decomposed, with carbon dioxide, filtered and evaporated to obtain sugar. The final disposition of the beet molasses is also unprofitable.

Refining.— The refining of sugar consists in washing, melting, purifying, evaporating and recrystallizing. Some factories in Louisiana turn out two or three grades of refined sugar or sugar that is sold direct to the trades, but as the process used by them for refining consists chiefly in washing with water, with a solution of tin chloride, ultramarine or phosphoric acid, it is expensive because of the large portion of the sugar that is dissolved while washing in the centrifugal machine. «White clarified,» «yellow clarified» and granulated sugars are the grades referred to, but the amount of these turned out is decreasing every year. The chief difference between refining and manufacturing of sugar is in the method of clarification. This is similar in almost every respect, except in the refinery, the sugar solution, after melting and chemical treatment and filtering, is filtered through "bone black" or bone charcoal. This substance has the property of decolorizing the sugar solution which leaves these filters in an almost colorless condition. The evaporation and crystallization are carried out in the same way as in manufacturing. The bone charcoal soon loses its power to decolorize and is then revivified by burning out the absorbed material in specially constructed retorts. The bone black will finally be exhausted of its valuable property of decolorizing and it is then sold to the fertilizer manufacturer for the manufacture of acid phosphates. The refuse molasses is used for making alcohol, for culinary purposes and to some extent for making lampblack and shoe polish.

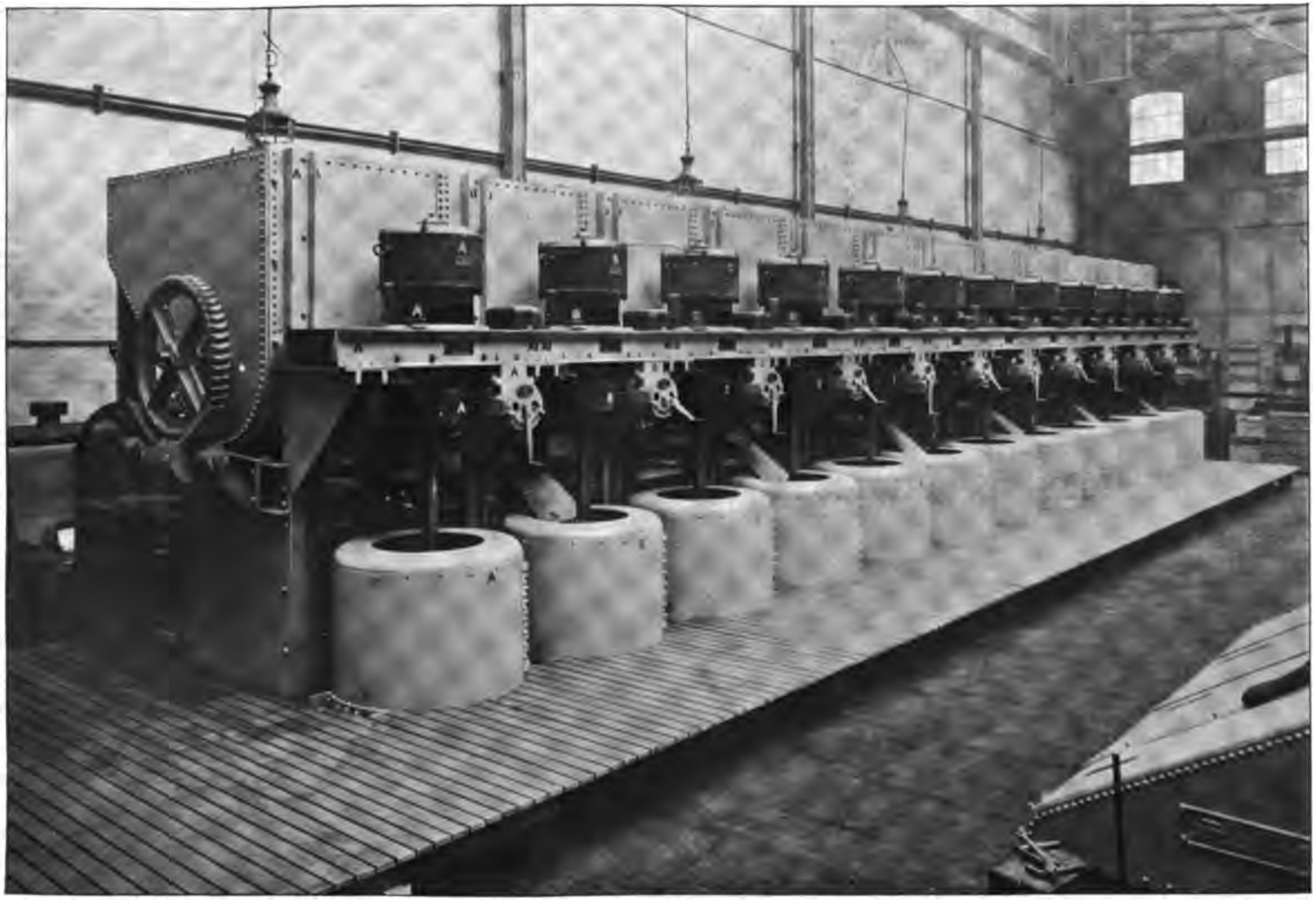


The National Cane Shredder and Mill.

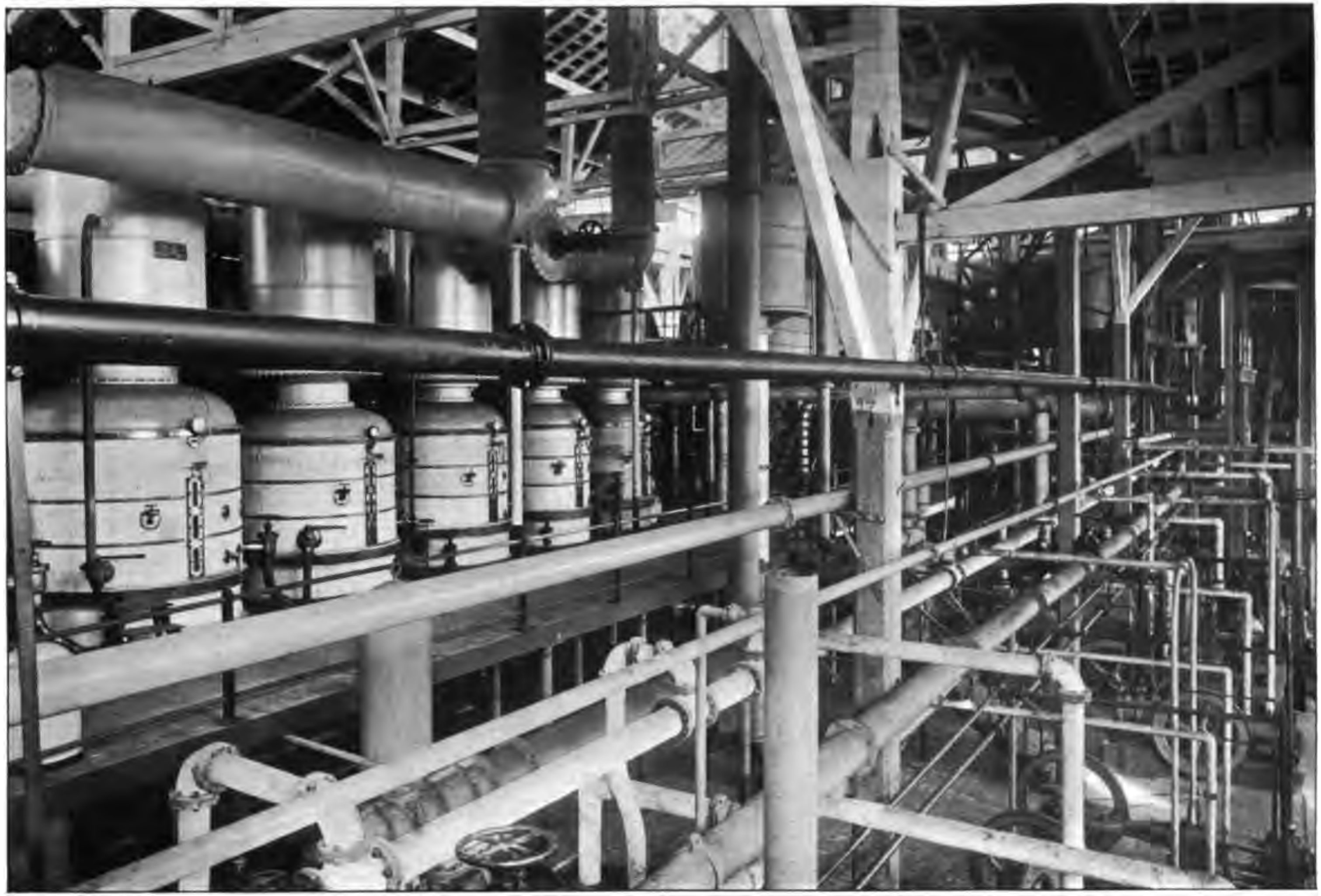
Comparison of Cane and Beet Sugar.— When highly refined, no one can distinguish between cane and beet sugar as they are one and the same thing. Between the crude or raw beet and cane sugars there is a great difference, the latter being edible while the former is not, as it possesses a very disagreeable odor and taste. Cane sugar molasses is good for culinary purposes, beet sugar molasses is not. Cane juice contains "glucose" (reducing sugars), but beet juice does not, though the latter contains raffinose and the former does not. In Louisiana about 20 tons per acre is an average cane crop, and 15 to 16 an average beet crop in the United States, Cane is worth $3 to $4 per ton and beets $4 to $4.50. Cane costs $30 to $35 per acre and beets $25 to $30. The sucrose content will vary in Louisiana from 10 to 16 per cent, and from 12 to 18 per cent in the beets in the United States. The cost of the production of a ton of sugar is $60 to $75, whether from cane or beets.

Palm Sugar.— The palm-sugar industry of India is a very old one, but insignificant compared with the sugarcane industry of that country. A fair estimate places the annual production of palm sugar about 100,000 tons of 2,204.5 pounds. The sugar palms are planted on dry land, and one planting will produce sugar from 5 to 25 years. The sugar season is from November to February. The sugar is obtained by tapping the tree. The tapping consists in making a triangular hole in the tree, into which the sap is collected. The sap is withdrawn from the tree by means of a spile in a hole bored beneath and inclined upward to the sap receptacle. Through this spile the sap runs out and is collected in earthenware vessels. The spile is generally made of bamboo cane. The flow of sap is more rapid at night than in the day and the cooler the night the greater the flow. A large tree will yield from 30 to 40 pounds of sugar annually and 800 trees is considered a valuable possession. The sap is collected daily, mixed with a little lime and evaporated in open vessels in a very crude way. The boiling is continued until the sap is a thick syrupy consistency or until it forms, on cooling, a solid mass. The solidifying or the last stages of evaporation is sometimes accomplished by exposure to the hot sun in that climate. The syrup is sometimes sold under the name of date-honey. This has been known for a very long time as an article of commerce.

Maple Sugar.— The variety of maple tree (*Acer barbatum*) is the one from which sugar is chiefly obtained. This tree grows wild in the forest or is cultivated in Ohio, Indiana, New York, Vermont and other northeastern States and to some extent in Canada. It is only within the last few decades that the trees have been cultivated to any great extent. A tree is 30 to 40 years old before it yields the maximum amount of sugar. A short tree with broad, spreading branches is said to produce larger yields and richer quality of sap than the tall ones with less foliage. The sugar period is from January to April. The sap begins to flow at the break-up of winter. So in one section the sap may flow as early as January while in the colder sections it may not flow before March. The flow lasts from six weeks to two months. The sap, or sugar, may be extracted from the tree in a manner similar to that of extracting it from the palm, but the triangular hole has proved to be more injurious than a small round hole. The general custom is to bore two to four holes in a tree, from two to four feet above the ground, with a three-quarter-inch augur. These holes are placed to southern



BATTERY ELECTRICALLY-DRIVEN CENTRIFUGAL MACHINES



INTERIOR CUBAN SUGAR FACTORY, SHOWING EVAPORATORS exposure and are slightly inclined upward. In the hole is arranged, water-tight, a spile made of wood or metal on which a tin pail or wooden bucket is hung to catch the sap. The flow of sap ceases with the budding of the tree. The sap is a very pure sugar juice containing from 2 to 4 per cent of sugar, the average being about 3.5 per cent. The sap contains, in addition to the sugar, other substances in solution, some of which are of an aromatic nature and these latter give to maple sugar its splendid flavor for which it is so highly prized as a material for making table syrup. The fact that the sap is of such a high degree of purity makes the manufacture of maple sugar very simple. The sap collected in the pails is poured through a strainer into a storage tank. From this tank the sap is drawn into vats or pans, usually made of Russia iron, 2.5 feet wide and about 5 feet long. These pans are set on grate bars in brick furnaces. The fuel used is wood, one cord of which is sufficient to evaporate the water from 100 pounds of sugar. The sap is evaporated with but little or no clarification except the removal of the scum as it rises to the top during the process of boiling. The cooking is continued until the sap is of a syrupy consistency or until it begins to grain; in the former case it is sold as syrup, in the latter, it is stirred while cooling in order to produce a soft granular sugar which is put on the market and sold for making table syrup. The annual production is estimated at 15,000 to 20,000 tons.

Sorghum and Maize Sugar.— Many experiments have been made to produce sugar from sorghum, but in all the results have not been profitable. There is now very little, if any, sugar made from sorghum, though there is considerable syrup. Maize contains 9 to 12 per cent sugar, but impurities along with it have not been successfully understood and no method exists by which this sugar can be profitably extracted.

Commerce.— The sugar trade of the world has become so great that international agreement has been necessary to regulate it. European countries for quite a number of years have paid directly and indirectly bounties to sugar producers and refiners on their exports. This encouraged and abnormally developed the sugar industry in some countries and depressed it in others. The bounties placed the price of sugar so high that the poorer people in bounty-paying countries could not afford it and so low in many non-bounty-paying countries that the industry was no longer profitable to producers. A movement was started in England in 1887 to correct this evil. A convention representing Austria, Belgium, Germany, Great Britain, Italy, the Netherlands, Russia and Spain met in London, 30 Aug. 1888, and passed a resolution to guarantee «that no open or disguised bounty shall be granted on the manufacture or exportation of sugar.» France would not enter the agreement because the United States would have nothing to do with it. There was no ratification of this convention, though it should have taken place 1 Aug. 1890. The bounties paid by Germany and Austria-Hungary were reported to be about $16 per ton, and this was approximately doubled in 1896. Renewed efforts were then made to break up the bounty system and this was practically accomplished, temporarily at least, in Brussels, 1 March 1902, after eight sittings of an international convention. This was the eighth European Sugar Bounty Conference since one held in Paris in 1862. Germany, Austria-Hungary, Belgium, Spain, France, Great Britain, Italy, the Netherlands and Sweden were represented in the convention of 1902. The following is a summary of the principal articles passed upon by that convention:

> «Article 1. The high contracting parties agree, from the date of putting in force this present convention, to suppress the direct and indirect bounties which might benefit the production or export of sugar, and not to establish bounties of this kind during the whole duration of this convention. The agreement applies to confectionery, chocolate, and all analogous products, containing sugar artificially incorporated in a notable proportion; and to all advantages resulting indirectly or directly for producers from fiscal legislation, including: (*a*) direct bounties granted to exports; (*b*) and to production; (*c*) total or partial exemption from taxation as to any part of the output; (*d*) advantages derived from excessive yield; (*e*) and from the exaggeration of drawback; (*f*) and from any surtax in excess of the rate fixed by article 3.
>
> 2. Sugar factories and refineries of all kinds are to be placed in bond and worked under the continuous supervision of revenue officers; and finished sugars are to be stored in bonded warehouses.
>
> 3. The surtax is limited to a maximum of 6 francs per 100 kilogrammes (2s. 5.25d. per cwt.; or £2, 8s. 9d. per ton) for refined and assimilable sugars; and 5 francs 50 centimes per 100 kilogrammes (25s. 8d. per cwt., or £2, 4s. 8.5d. per ton) for other sugars. The surtax is the difference between the rate of the duty imposed on imported foreign sugar and the rate of duty or tax imposed on the home product. The provisions of this article do not apply to import duties on sugar imposed by countries that do not produce sugar, nor to the by-products of sugar manufacturing or sugar refining.
>
> 4. The high contracting parties agree to impose a special duty on the importation into their respective territories of sugars from countries that grant bounties either on production or export. This duty shall not be less than the amount of the bounties direct or indirect granted in the country of origin and each of the parties reserves the right to prohibit the importation of bountied sugars. In order to compute the advantages which may be derived from the imposition of an excessive surtax as specified in paragraph 5 of article 1, the surtax, at the agreed rate fixed by article 3, is deducted from such excessive surtax, and the half of the difference is considered to represent bounty. A permanent commission, instituted by article 7, will have the right, on the demand of a contracting party, to revise the rate imposed in excess.
>
> 5. The high contracting parties agree to admit, at the lowest rate of import duty, sugars of any of the contracting countries, or of any colonies or possessions belonging to them that do not grant bounties, and to which the obligations imposed by article 8 apply.
>
> 6. Spain, Italy, and Sweden are exempt from articles 1, 2, and 3 as long as they do not export sugars.
>
> 10. The convention to come into force 1 Sept. 1903 remain five years from that date; and thenceforward (in case no state denounces it, 12 months before 1 Sept. 1908) it will remain for a year and so on from year to year. The denunciation will only have effect on the party making it.
>
> 12. The convention shall be ratified at Brussels on or before 1 Feb. 1903.»

The effect of this international agreement in Europe practically shut off importations of sugar from that continent to the United States, which, however, (including its possessions, Hawaii, Porto Rico and the Philippine Islands) together with Cuba produce sufficient to supply the demand for sugar in the United States.

DUTY PER 100 POUNDS ON CUBAN SUGARS IMPORTED INTO THE UNITED STATES.

Test	Old Rates	New Rates
75 raw	$0.76	$1.75
89 raw	1.152	1.05
96 raw	1.348	1.28
Refined	1.560	1.33

All Cuban sugars coming into the United States are allowed 20 per cent discount on above rates.

In 1916 a provision in the Underwood Tariff

Law, by which sugar was eventually to go on the free list, was rescinded by Congress. The imports of sugar into the United States from 1915 to 1918 were as follows:

	Short tons
1915	2,710,500
1916	2,816,581
1917	2,666,373
1918	2,451,664

The exports during the same period were:

	Short tons
1915	300,552
1916	842,598
1917	634,153
1918	293,753

SUGAR PRODUCTION OF THE WORLD FOR FOLLOWING YEARS:

	Cane	Beet	Total
	Short tons	*Short tons*	*Short tons*
1905–06	7,551,000	8,090,000	15,641,000
1906–07	8,365,000	7,587,000	15,952,000
1907–08	7,926,000	7,390,000	15,316,000
1908–09	8,654,000	7,350,000	16,004,000
1909–10	9,423,000	6,991,000	16,414,000
1910–11	9,540,000	9,042,000	18,582,000
1911–12	10,275,000	7,072,000	17,347,000
1912–13	10,908,000	9,509,769	20,417,769
1913–14	11,225,000	9,430,145	20,655,145

During the World War, 1914–18, the world's sugar production was as follows:

	Short tons
1915	20,755,960
1916	18,547,373
1917	18,572,220

THE CANE AND BEET SUGAR CROPS OF THE WORLD FOR 1914–15, WITH AVERAGE OF CROPS FOR SEVEN PRECEDING YEARS.

CANE SUGAR

	Crops 1914–15 (Tons of 2,240 lbs.)	Average crop for 7 years ending 1914–15
Africa		
Egypt	83,000	64,263
Mauritius	303,000	233,142
Reunion	44,000	40,714
Natal	115,000	61,316
Total in Africa	545,000	399,435
America		
Argentina	370,000	192,744
Brazil	269,000	251,000
British Guiana	120,000	108,181
Trinidad	46,000	46,536
Barbados	32,000	33,299
America — *continued*		
Jamaica	15,000	13,444
Antigua and Saint Kitts	14,000	22,553
Total	866,000	667,757
Central America		
Costa Rica	2,500	2,371
Guatemala	7,500	7,407
Nicaragua	4,000	1,247
Salvador	18,000	8,057
Total in Central America	32,000	22,082
Cuba	2,980,000	2,025,588
Danish	5,000	10,714
French colonies		
Guadeloupe	44,000	38,154
Martinique	44,000	40,209
Haiti and San Domingo	119,000	94,143
Total	3,192,000	2,208,808
Mexico	121,000	132,254
Asia		
British India	2,561,000	2,273,330
Formosa	222,000	130,557
Java	1,541,000	1,291,985
Philippine Islands	408,000	223,916
Total	4,732,000	3,919,788
North America		
United States (contiguous)		
Louisiana	240,000	280,000
Texas	44,000	10,142
Non-contiguous		
Hawaii	612,000	496,829
Porto Rico	364,000	28,243
Total United States except Philippine Islands	1,260,000	815,214
Oceania		
Queensland	269,000	206,164
New South Wales		
Fiji	114,000	78,100
Total	383,000	284,264
Europe		
Spain	8,000	13,429

SUMMARY

Africa	545,000	399,435
America	866,000	667,757
Asia	4,732,000	3,919,788
Europe	8,000	13,429
Oceania	383,000	284,264
Cuba	3,192,000	2,208,808
North America	1,260,000	815,214
Mexico	121,000	132,254
Central America	32,000	22,082
Total production cane sugar in the world	11,139,000	8,863,031

BEET SUGAR

	1905–06	1906–07	1907–08	1908–09	1909–10	1912–13	1913–14	1914–15	Average for 7 years
North America									
United States	279,393	431,796	413,954	380,254	457,562	692,556	733,401	722,054	547,382
Canada	11,419	11,367	7,943	6,964	8,802	12,439	11,982	13,773	10,467
Europe									
Austria-Hungary	1,509,789	1,343,940	1,424,657	1,398,000	1,260,000	1,442,159	1,287,787	1,288,960	1,349,357
Belgium	328,770	282,804	232,352	258,000	250,000	326,653	251,023	224,437	260,752
France	1,089,684	756,094	727,712	802,000	825,000	967,440	790,790	333,953	743,284
Germany	2,418,156	2,239,179	2,129,597	2,080,000	2,040,000	2,983,085	2,993,704	2,755,750	2,454,476
Netherlands	207,189	181,417	175,184	214,000	200,000	315,775	231,073	263,852	255,498
Russia	986,500	1,440,130	1,410,000	1,265,000	1,150,000	1,361,842	1,688,247	....	1,328,817
Other countries	410,255	467,244	462,772	500,000	460,000	427,500	431,220	....	451,284
Total beet	7,223,155	7,153,971	6,984,171	6,904,218	6,651,364	8,101,949	7,988,007	5,602,779	7,401,317
Grand total cane and beet sugar	13,964,988	14,506,811	13,900,539	14,531,108	14,495,692	20,518,000	20,605,000	18,041,779	16,668,417

Sugar Consumed in the United States, 1914.
(*Willet and Gray of N. Y.*)

Imported (including 510,385 tons Hawaiian, 274,149 Porto Rico, and 120,887 Philippine).	2,972,333
Domestic manufactured from imported molasses, U. S. Maple, etc.	20,200
Domestic cane	143,996
Domestic beet	624,298
Domestic total	788,494
Total annual product consumed in the United States is 84.29 pounds per capita	3,760,827

From 2,238,588 tons in 1900 the consumption of sugar in 1918 had reached 4,339,616 tons.

Consumption of Sugar Per Capita — Licht's Estimate for 1914.

	Per capita in pounds		Per capita in pounds
Germany	45.13	Netherlands	50.09
Austria	29.17	Denmark	95.57
France	43.85	Italy	11.68
Spain	14.19	Belgium	36.08
England	93.37	Turkey	21.93
Switzerland	73.55	Sweden	57.73
United States	84.29	Norway	46.64
Russia	25.43		

From 1916 to 1918 the sugar production of the United States was as follows:

	Cane	Beet	Total
	Short tons	*Short tons*	*Short tons*
1916	138,620	874,222	1,012,842
1917	310,900	820,657	1,131,557
1918	245,839	764,811	1,010,650

The large increase in sugar export during these years was due to the European War. Early in the fall of 1917 the International Sugar Committee was formed to arrange for the distribution of the available sugar in the world. The committee consisted of two members from each of the allied governments, two from the United States Food Administration being also supplemented by the head of the sugar division. This committee arranged for the purchase and distribution of all sugar to the allied countries, and as it became difficult to procure household supplies, in December 1917 the United States Senate directed an inquiry into the causes of the shortage of sugar. This was found to be due largely to consumer hoarding, and to the unusual amounts used for home preserves, also to about two-fifths of the whole quantity consumed in the United States being required for the manufacture of candy. The efficiency of the Food Administration, of the International Committee and the willing co-operation of the people served to keep down the price, to regulate the supply and to tide over the difficulty and the shortages occasioned by the indiscriminate sinkings of merchant vessels through the German submarine policy.

In 1916 the government of Panama was authorized to loan $500,000 to plantation operators for the development of the sugar industry in that country, the loans to be repaid within 10 years; a government subsidy of one cent on every four pounds of white granulated sugar produced was also granted. In 1917, from its development fund, Great Britain also made a grant of $625,000 for the development of sugar-beet growing and manufacture in England.

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SUGAR OF LEAD. See Lead.

SUGAR LOAF, The, an isolated, conical hill, rising from the east bank of the Hudson River, a short distance below Garrisons. It is at the north entrance to the Highlands, about 57 miles north of New York.

SUGAR MAPLE. See Maple.

SUGGESTION, *in psychology,* a term which in its widest sense signifies an intimation, a hint, a prompting, the abrupt introduction of an idea into consciousness. It is also employed as synonymous with association. But, more specifically, it is a method of effecting belief, whether the conditions of the subject be normal, or abnormal, as in the case of hypnotism (q.v.). Under normal conditions this belief may be manifested as a conviction arrived at by reasoning, as in the case of the acceptance of a series of logical arguments; or it may be mere acquiescence in what deliberation would show to be false. Psychologists disagree as to the means by which suggestion may effect belief under abnormal conditions (for example, those of hypnotism). Lipps holds that the critical faculties of the hypnotized subject are kept in abeyance, and he is, therefore, incapable of making opposition and thereby destroying the belief. Wundt contends that the consciousness of the subject is limited, no ideas entering save those directly aroused. Such ideas are, therefore, freed from contradiction, and have a special or hyperæsthetic force. When belief persists for a time after hypnotic conditions have ceased to exist, and ultimately takes effect, such form is called post-hypnotic suggestion. Consult Bain, ‘The Senses and the Intellect’ (London 1894); Bernheim, ‘Suggestive Therapeutics’ (trans., New York 1889); Binet, A., ‘La Suggestibilite’ (Paris 1900); Keatinge, W. M., ‘Suggestion in Education’ (London 1907); Lipps, ‘Zur Psychologie der Suggestion’ (1897); Sidis, B., ‘The Psychology of Suggestion’ (New York 1898); Stoll, O., ‘Suggestion und Hypnotismus in der Völkerpsychologie’ (2d ed., Leipzig 1904); Wundt, ‘Hypnotismus und Suggestion’ (Leipzig 1911).

SUHL, zool, Germany, city in Prussian judicial district Erfurt, on the southern slope of the Thuringen Forest, in the valley of the Hasel. It is situated on the State Railroad Plaue-Ritschenhausen and has two Evangelical and one Catholic church, synagogues, a city hall, upper Realschule, law court, etc. It is noted for its arms manufacturing, an ancient industry. Other manufactures are porcelain, machinery, ammunition, hardware, woodenware and toys, besides iron foundries, screwwork, etc. Its records reach back to 1330.

SUICIDE, the act of intentionally destroying one's own life, whether sane or insane — the act in itself, accompanied by the purpose, is suicide; the condition of sanity or insanity bears on the question of responsibility. In considering the causes which lead to suicide it may be well to mention the motives which deter from it. First of all is the natural love of life, which leads even condemned criminals, perhaps awaiting death by torture, to cling to the few hours or days remaining to them. This love of life is in the very nature of all living beings, and it is not always or even usually to be measured by the apparent value of existence to the individual. It is at least as strong in the Digger Indian or the Kongo negro as in the civilized and well-to-do resident of America or Europe. There is next, among the more intelligent, whether religiously inclined or not, the sense of duty to others; among the strictly religious, there is the dread of punishment beyond the grave, and statistics indicate that this is a potent and prevalent deterrent from self-destruction.

Suicide is not in itself a sign of weakness of intellect. There were periods of depression in the Revolutionary struggle when Washington was despondent almost to the point of welcoming death, and Bismarck once contemplated suicide. Napoleon, after his first overthrow, attempted suicide by taking poison. Hannibal committed suicide. Herndon, Abraham Lincoln's law partner, relates that after the death of Miss Rutledge, whom Lincoln loved, his friends watched him closely for fear that "the dark and gloomy weather might produce such a depression of spirits as to induce him to take his own life." Instances might be multiplied of the world's greatest men who either committed suicide, or attempted it, or were on the brink of it.

Although there are no statistics for comparison, yet the observations of trustworthy narrators indicate that suicide is very much more common among Asiatics than among Western nations. Arthur H. Smith, D.D., says there are parts of China in which young girls band themselves into a secret league to commit suicide within a certain time after they have been betrothed or married, that the practice of suicide "is adopted even by children, and for causes relatively trifling. At times it appears to spread like the smallpox, and the thirst for suicide becomes virtually an epidemic." China is probably the only country in the world in which criminals are permitted, or rather directed as an act of special grace, to commit suicide. Before the Japanese adopted civilized methods suicide was also prevalent among them, the usual form being known as "hari-kari or seppuku" the victim disemboweling himself with knife or sword. In India vast numbers of fanatics sought death under the car of Juggernaut, and widows on the funeral pyres of their husbands, until the British authorities put a stop to these practices.

It is yet an undecided question whether education fosters the tendency to suicide or not. Thomas Garrigue Masaryk (q.v.), first President of the Czecho-Slovak Republic, when a lecturer on philosophy at Vienna in 1879, came into prominence by a study on "Suicide" as a pathological symptom of the condition of contemporary Europe. He attributed its chief cause to the decline of religious sentiment. It cannot be alleged that education has anything to do with the epidemics of suicide among Chinese women. On the other hand, it is easy to suppose, and statistics appear to support the presumption, that, other things equal, a prevalence of materialism, a disbelief in things supernatural, and consequent loss of assurance that privations and sufferings here are to be recompensed by an eternity of happiness hereafter, tend to make men tired of life and willing to anticipate by a few years their inevitable destiny. Bismarck said that "if this world were the end of all, it would not be worth the dressing and the undressing." So far, therefore, as education helps to promote materialism, it promotes suicide. At the same time it is to be remembered that such men as Tyndall and Darwin, who were avowedly in discord with accepted religious tenets, regarded it as a duty and a pleasure to live and do their share of life's work.

Professor Bailey, of the Social Science Department at Yale, after examining 10,000 cases of suicide, arrived at the following conclusions:

"Three and one-half males commit suicide to every female. From 30 to 40 is the popular suicide age, and the married are more apt to do away with themselves than the single. Among the single the maximum number of cases is between 20 and 30; among married persons between 30 and 40; among widowers, between 60 and 70, and among divorced persons the same. In this country shooting is the favorite method of suicide, poisoning being a close second. Hanging is more popular in northern Europe, and drownings in southern countries. In Maine most of the suicides hang themselves; in the cities they jump from buildings or bridges, poison themselves or turn on the gas; in the South they shoot themselves. Women drown themselves, use poison and gas. Women as a rule commit suicide in such a way as to avoid injuring their features. Young persons seem to prefer poison; the middle-aged shoot themselves and older people hang themselves. Despondency leads as the cause of suicides in America."

New York is the only American State in which attempted suicide is prosecuted as a crime. In England attempted suicide is also criminal, and the body of a person found to have committed suicide while sane is debarred from Christian burial. The feelings of relatives are almost invariably spared, however, both in America and England, by a verdict of the coroner's jury that the act was the result of insanity.

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SUIDÆ, sū'ĭ-dē, the family which includes the pigs (genus *Sus*) and other relatives, characterized by the rooting snout, bristly coat, large and low hind hoofs, peculiar dentition and other common features. See SWINE OR HOGS.

SUIDAS, sū'ĭ-dăs, Greek lexicographer of the 10th or 11th century. He wrote a lexicon which forms a kind of cyclopædia and dictionary, giving explanations of words, and notices of persons, places, etc., in alphabetical order.

SUIR, shoor, Ireland, a river which rises in the Slieve-Bloom Mountains, in the north of Tipperary; flows in an irregular course, forming the boundary between Tipperary, Waterford and Kilkenny; passes the towns of Clonmel and Carrick; and after a course of about 80 miles unites with the Barrow to form the estuary of Waterford harbor. It is navigable by vessels of 500 tons to Waterford, and by large barges to Clonmel.

SUKA-SAPTATI, soo'ka-säp'ta-tē, Sanskrit, ‘Seventy (Tales) of a Parrot,’ taken from Nakshabi's ‘Túti Náma,’ or Parrot Book (A.D. 1320). It is the Persian story of a merchant leaving his young wife for a 70 days' journey. He commends her always to obtain advice by consulting his wonderful trained parrot in every emergency. The bird's advice is solicited early when the wife has temptation thrown her way and the parrot temporized with her by telling a story which so pleased and flattered her that she spent the night listening to the absorbing relation. And with the sunrise the advice was declared by the parrot to be contingent upon what happened under the conditions that prevailed in a story which he would recite the next evening. The following night's story aroused equal interest in the wife, but is indissolubly connected with another night's story which the parrot recites so entertainingly that in this manner the luring continuations of the tales keep the tempted wife from erring the remaining evenings of the 70 days' absence of the merchant. And the husband returns to find his wife saved from dishonor. Consult Schmidt, ‘Uber die Suka-Saptati’ (Halle 1898); MacDonnell, A. A., ‘History of Sanskrit Literature’ (London 1913); Wortham's ‘Enchanted Parrot’ (London 1911) contains several of these parrot stories.

SUKHAVATI, sook-hä'va-tē, Sanskrit, blissful. The Mahayana Buddhist's Land of Bliss, the heaven he reaches in the course of his transmigrations if a believer in Amitabha Buddha who presides over it. Gods and men are here on a perfect equality, earthly ills do not exist and the seasons and days are not Elevation to this heaven is by absolute trust in the presiding deity. Consult Suzuki, D. F., ‘Outlines of Mahâyana Buddhisms’ (London 1907).

SULEIMAN PASHA, soo-lā-män' păsh'â, Turkish military officer: b. 1840; d. 11 Aug. 1892. After entering the army he was made a major in 1867; colonel in 1873, and general of brigade in 1874. In 1876 he distinguished himself as commander against the Servians. When the Russians declared war (1877) against Turkey, Suleiman checked them at Eski Zagra, and destroyed his army in heroic but vain attempts to force them from the Shipka Pass. In October he was appointed commander-in-chief of the Army of the Danube, but failed to accomplish anything, retreated behind the Balkans, and suffered defeat near Philippopolis (January 1878). Brought before a court-martial, he was condemned to be degraded and kept in a fortress prison for 15 years. The Sultan, however, pardoned him.

SULIMAN (soo-lē-män') **MOUNTAINS**, India, a range of the Northwest Frontier Province, near the Afghanistan frontier. The range consists of several parallel ridges, of which the most westerly form the water-parting between the rivers flowing east to the Indus and those flowing westward through Afghanistan. It extends north and south from the Safed Koh to about the Bolan Pass, and is crossed by many passes, of which the chief are those of Kuram, Gumal and Sangar. The highest peak, Takht-i-Suliman, or «Suliman's Seat,» has two summits, 11,295 and 11,070 feet high respectively. These mountains are generally rocky and precipitous, and their sides are completely bare of trees. The passes through them are generally held by independent tribes in alliance with the British.

SULINA, soo-lē'nä, Rumania, the central arm of the Danube delta. In 1902 extensive improvements were completed which rendered it a navigable ship canal, and the commercial entrance to the Danube. At its mouth is the town of Sulina, which is a free port with a population of about 5,611, and an extensive transit trade.

SULIOTS, sōō'lĭ-ōtz, a mixed people of Arnaout and Greek descent, who, to escape the tyranny of the Turks in the 17th century, settled in the mountains near Parga, occupying a wild valley enclosed on three sides by almost inaccessible mountains, and accessible on the fourth only by a narrow defile. Here their numbers had increased toward the end of the 18th century to 10,000, their chief village being called Suli. Their government was republican. Old customs were followed instead of written laws. They were distinguished for the simplicity of their manners and for their bravery. Their mother-tongue was the Albanian, but they also spoke Greek. They lived partly by the rearing of cattle and the chase, and partly by plunder. When, after a struggle of several years, Ali, pasha of Yanina, had rather reduced them to despair than conquered them (1803), most of them abandoned their country. But when Ali found himself hard pressed by the Turks and deserted by the Albanians, he recalled the Suliots to his assistance. When the Greek war of independence broke out, the Suliots joined the Greeks. Suli was besieged by the Turks, and in September 1822 was compelled by famine to surrender. Three thousand Suliots then embarked in British ships for Cephalonia; the rest dispersed themselves in the mountains. The corps of 500 men, raised and equipped by Lord Byron at his own expense, was composed of Suliots, for whom he had a great admiration. See BOZZARIS.

SULLA, sŭl'ạ, **Lucius Cornelius**, Roman dictator: b. 138 B.C.; d. 78 B.C. He received a good education, but was notorious from his youth upward for his excessive dissipation and debauchery. He served with distinction under Marius in the Jugurthine (107 B.C.) and Cimbrian (104–2) wars, and in 93 was chosen prætor. For his services in the Social war (90–88) he was appointed consul (88 B.C.), and the province of Asia, with the conduct of the war against Mithridates, fell to his lot. Marius was also ambitious of his command, and resorted to acts of violence to carry his point, by which Sulla was compelled to escape from Rome. But Sulla re-entered the city at the head of his army, drove Marius to Africa, and then sailed for Greece at the beginning of 87 B.C. He expelled the armies of Mithridates from Europe (86), crossed into Asia (84) and was everywhere victorious, gaining plenty of wealth for himself and his soldiers, and forcing Mithridates to conclude a peace. Marius had died in 86 B.C., after proscribing Sulla and confiscating his property, but the party of Marius was still strong. Sulla now hastened to Italy, and landed at Brundusium with 40,000 men 83 B.C. He was joined by many of his friends who had been banished from Rome. He gained four battles over the Roman forces in person, and defeated a Samnite army under Telesinus. He entered the city victorious in 82, and immediately put to death between 6,000 and 7,000 prisoners of war in the Circus. Rome and all the provinces of Italy were filled with the most revolting scenes of cruelty. After satisfying his vengeance by the murder or proscription of thousands he caused himself to be named dictator for an indefinite period (81 B.C.). He ruled without restraint, repealed and made laws, abolished the tribuneship, and settled his veterans in various parts of Italy. In 79 B.C. he laid down his dictatorship.

SULLINS (sul'ĭnz) **COLLEGE**, a college for women, located at Bristol, on the State line between Virginia and Tennessee. It was founded in 1870 by David Sullins, a minister of the Methodist Episcopal Church, South, and is under the control of the Holston Conference of that church. It has an elementary, a preparatory and a collegiate department. The collegiate course leads to the degree of A.B.; courses in pedagogy are offered; there is also a business course of one year, a School of Expression and Physical Culture, a School of Art and a Department of Music. Physical exercise is encouraged, and a course in light gymnastics is required of all students. The college has a beautiful and healthful situation; the grounds and buildings are valued at $75,000. The students average annually 230, and the faculty numbers 22.

SULLIVAN, SIR Arthur Seymour, English composer: b. London, 13 May 1842; d. 22 Nov. 1900. His father was a military bandmaster, and taught his son before nine years of age to play every wind-instrument used in the band, thus laying the foundation of the wide orchestral knowledge afterward displayed by Sir Arthur. Endowed with a fine treble voice he became a choir-boy at the Chapel Royal; in 1856 gained the Mendelssohn scholarship of the Royal Academy of Music, where he continued his musical education; and in 1858 went to Leipzig, completing his studies with Moscheles, Hauptmann, and other famous instructors of that period. On his return to England in 1862 he at once attracted attention by his music to Shakespeare's 'Tempest.' His serious works include the oratorios 'Prodigal Son,' and 'Light of the World,' anthems, hymns, numerous favorite songs, etc.; but his most popular compositions are the Savoy series of burlesque operettas which he produced in conjunction with W. S. Gilbert. Among the most popular of these are 'H. M. S. Pinafore' (1878); 'Pirates of Penzance' (1880); 'Patience' (1881); 'Iolanthe' (1882); 'Mikado' (1885); 'The Yeoman of the Guard' (1888), and the 'Gondoliers' (1889). In 1886 he set to music an arrangement of Longfellow's 'Golden Legend,' which is one of his finest compositions, and in 1891 produced his grand opera 'Ivanhoe,' a masterly work which did not win the success its merits deserved. He was knighted in 1883. Consult Cellier and Bridgman, 'Gilbert and Sullivan and their Operas' (Boston 1914); Findon, B. W., 'Sir A. Sullivan, His Life and Music' (London 1903); Lawrence, A., 'Sir A. Sullivan, Life-story, Letters and Reminiscences' (London 1900); Wyndham, H. S., 'Arthur Sullivan' (London 1904).

SULLIVAN, John, American military officer: b. Berwick, Me., 17 Feb. 1740; d. 1795. He received, in 1772, the commission of major, and in 1775 that of brigadier-general. The next year he was sent to Canada, and on the death of General Thomas, the command of the army devolved on him. In this year he was promoted to the rank of major-general, and was soon after captured by the British in the battle on Long Island. He commanded a division of the army at the battles of Trenton, Brandywine and Germantown; and was the sole commander of an expedition to the island of Newport, which failed through want of co-operation from the French fleet. In 1779 he commanded an expedition against the Indians. He was afterward a member of Congress, and for three years president of New Hampshire. In 1789 he was appointed a judge of the District Court and continued in that office till his death.

SULLIVAN, John Lawrence, American pugilist: b. Boston, Mass., 15 Oct. 1858; d. West Abington, Mass., 2 Feb. 1918. This remarkable man, who has not inaptly been described as "the last of the gladiators," was the principal exponent of a science that seems to have passed out of vogue. Endowed with herculean strength and physique, together with the necessary concomitants of courage and pugnacity, his picturesque figure and exciting career were typical of the ancient gladiator. At 19 he fought his first battle on the stage of a Boston theatre when he knocked out a pugilist named Scannell, who had challenged any man in the audience. Hereafter he adopted fighting as his profession. His feats of strength earned him the sobriquet of «the Boston Strong Boy,» and in 1878 he made his debut as a professional by knocking out «Cockney» Woods. On 7 Feb. 1882 he met and defeated Paddy Ryan in a bare-knuckle fight at Mississippi City for $5,000 a side and the championship of America. Sullivan's trainer, Billy Madden, is said to have coined the now well-known phrase «knockout» on this occasion. His next important fight was in 1888, with «Charlie» Mitchell (q.v.), ending as a draw at the 39th round, and on 8 July 1889 he fought his greatest battle, that with Jake Kilrain, at Richburg, Miss. This was the last championship fight in America under London Prize Ring rules and gave Sullivan the victory in 75 rounds. His contest with Mitchell proved that the only method likely to succeed against him was that of agility in keeping beyond the range of his powerful right-hand blows, and it was by adopting these tactics that James J. Corbett deprived Sullivan of the championship in 21 rounds at New Orleans on 7 Sept. 1892. This was his last contest, after being champion of the world for 12 years. His bohemian style of life had injured his magnificent constitution. In his later days he became an ardent advocate of temperance and retired to the farm where he died.

SULLIVAN, Sir William Wilfrid, Canadian statesman: b. New London, Prince Edward Island, 1843. He was educated at Saint Dunstan's College, and was called to the bar in 1867. He was a member of the provincial legislature, elected as a conservative, till 1889, becoming premier and attorney-general (1879–89), and being raised in the latter year to chief justice. Knighthood was conferred on him in 1914.

SULLIVAN, Ill., city and capital of Moultrie County, on the Wabash, the Chicago and Eastern Illinois and the Illinois Central railroads. It contains the Illinois Masonic Home and hospital, and its industrial establishments consist of a planing mill, flour mill, machine shops, grain elevators, etc. Pop. 2,621.

SULLIVAN, Ind., city and capital of Sullivan County, on the Evansville and Terre Haute and the Illinois Central, the Chicago and Eastern Illinois and the Chicago, Terre Haute and Southwestern railroads. It is two miles west of Terre Haute, and has coal mining and other industries, and contains a Carnegie library, Elks' Home, etc. Pop. 4,115.

SULLIVAN'S ISLAND, at the north entrance to Charleston Harbor, South Carolina, six miles out from Charleston. It is separated from the mainland by a tidal channel. On this island is the well-known Fort Moultrie (q.v.). The island is about six miles long. It is a favorite resort for sea-bathing. Steam ferry-boats ply regularly between the city and the island.

SULLY, sŭl'ĭ, **Alfred,** American military officer: b. Philadelphia, Pa., 1821; d. Fort Vancouver, Wash., 17 April 1879. He was graduated at the United States Military Academy in 1841 and assigned to the Second infantry, with which he took part in the Seminole War and served in the war with Mexico in 1846–47. In 1861–62 he won distinction in the battles of Fair Oaks and Malvern Hill; was promoted brigadier-general of volunteers in October 1862. In 1863 he was given command of the Department of Dakota and greatly distinguished himself in his campaigns against hostile Indians. At the close of the war he was brevetted major-general of volunteers, and brigadier-general, United States army, for gallantry during the war, and was promoted colonel of the 10th infantry in 1872.

SULLY, James, English philosopher: b. Somerset, 3 March 1842. He was educated in the Independent College at Taunton and in Regent's Park College, London. He afterward studied at the universities of Göttingen and Berlin, and in 1871 began to contribute to newspapers and reviews. From 1892 to 1903 he was Grote professor of the philosophy of mind and logic in University College, London, and also held the post of lecturer on education at the College of Preceptors. He published ‘Sensation and Intuition’ (1874); ‘Pessimism: a History and a Criticism’ (1877), containing acute criticism of Schopenhauer and Von Hartmann; ‘Illusions’ (1881), in the International Scientific Series; ‘Outlines of Psychology,’ with especial reference to the theory of education (1884); ‘The Teacher's Handbook of Psychology’ (1886), based upon the preceding work; ‘The Human Mind’ (1892); ‘Studies of Childhood’ (1895); ‘Children's Ways’ (1897); ‘Essay on Laughter: Its Forms, its Causes, its Development and its Value’ (1902); ‘Italian Travel Sketches’ (1912).

SULLY, sŭl'ĭ, **Thomas,** American artist: b. England, 1783; d. Philadelphia, 5 Nov. 1872. He came to the United States with his parents, who were actors, in 1792; studied painting in Charleston, S. C., and Richmond, Va., and in 1806 removed to New York. In 1809 he went to London to complete his studies. Two years later he returned and settled in Philadelphia. His reputation as one of the leading American portrait painters is founded on numerous works, the best known of which are the full-length portraits of Dr. Benjamin Rush, Commodore Decatur, Thomas Jefferson and Lafayette. The Boston Museum possesses his celebrated picture of ‘Washington Crossing the Delaware.’

SULLY-PRUDHOMME, sü-lē prü-dŏm, **René François Armand,** French poet: b. Paris, 16 May 1839; d. Chatenay, 6 Sept. 1907. He studied law, but turned entirely to letters; published his first verses ‘Stances et Poèmes,’ in 1865, and gained praise from Sainte-Beuve, and followed up his success by several volumes, grave in manner, with finished versification and subtle in thought. Pre-eminently a thinker, he attempted a poetic treatment of abstract themes in the didactic ‘La Justice’ (1878) and ‘Le Bonheur’ (1888). He also made a metrical rendering of Book I of Lucretius' 'De Rerum Natura,' accurate enough, but somewhat ragged (new ed., 1886), and published in prose, 'Réflexions sur l'Art des Vers' (1892), and a noteworthy article on Pascal in the *Revue des Deux Mondes* (1895). In 1881 he was chosen to the Academy and in 1882–88 his 'Œuvres Complètes' appeared. Among the titles of several individual volumes are 'Les Epreuves' (1866); 'Les Solitudes' (1869); 'Les Destins' (1872). In 1901 he won the Nobel prize for literature.

SULPHANILIC ACID, Para-Aminobenzene Sulphonic Acid, $C_6H_4\left\langle\begin{matrix}NH_2\\OS_3H\end{matrix}\right.$ p., or, $C_6H_4\left\langle\begin{matrix}NH_3\\SO_3\end{matrix}\right\rangle$, was first prepared by Gerhardt in 1845. It is usually obtained by heating aniline with fuming sulphuric acid at 180° C., for several hours. Upon pouring the reaction mixture into cold water a fairly pure product is obtained, which may be further purified by converting into the sodium salt and by treating the latter with animal charcoal. Sulphanilic acid has also been prepared by a patented process (Ger. 205150), which consists in heating chlor-benzene-p. sulphonic acid with ammonia under pressure in the presence of cupric chloride. Under this treatment the chlorine atom is readily replaced by the NH_2 group. Sulphanilic acid crystallizes from hot water in plates with one molecule of water of crystallization. It has no definite melting point; upon heating it decomposes between 280°–300° C. One part of the acid dissolves in 112 parts of water at 15° C. Upon oxidation with manganese dioxide and sulphuric acid it forms quinone. Fused with caustic potash it yields aniline and with bromine water it is readily converted into tribromaniline.

Sulphanilic acid is of special importance as an intermediate in the manufacture of azo-dyes. When its sodium salt is treated with sodium nitrite in the presence of sulphuric acid, diazobenzene sulphonic acid is formed, which may be readily coupled with a number of reagents forming important azo-dyes. With phenol the diazo compound forms Tropaeolin Y. With resorcin it yields Resorcin Yellow. With dimethyl aniline it forms Helianthine, the alkaline salt of which is the well-known indicator Methyl Orange. With alpha-naphthol the diazo compound forms Orange I, one of the seven food colors, and with beta-naphthol it forms Orange II. Sulphanilic acid has also been used for the manufacture of Resorcin Brown, Azofuchsine G, Hessian Brown MM, Benzo-Brown G, Columbia Green, and Conogo Brown G.

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SULPHIDE COPPER ORES. The principal sulphide copper ores of the United States are chalcocite or copper glance (Cu_2S), containing 79.8 per cent of metallic copper; enargite (Cu_3AsS_4), 48.3 per cent; covellite (CuS), 66.4 per cent; chalcopyrite or copper pyrites ($CuFeS_2$), 34.5 per cent; bornite or peacock ore (Cu_5FeS_4), 50 to 70 per cent. Other sulphide copper ores of less commercial importance because in small quantity are: tetrahedrite ($4Cu_2S.Sb_2S_3$), 25 to 40 per cent metallic copper; tennantite ($4Cu_2S.As_2S_3$), 57.5 per cent; chalcanthite ($CuSO_4+5H_2O$), 25.4 per cent; chalmersite ($CuFe_2S_3$); cubanite ($CuFe_2S_4$); and the rare carrollite ($CuCo_2S_4$). As all these minerals show evidences of recent formation they are regarded as probably concentrations from pyrite beds. Chalcopyrite and bornite seem to have been the primary deposits from which the others have been derived. In most localities the ores are of such low grade that water concentration is necessary before smelting. Nevertheless the sulphide ores must be regarded as the most important of all ores of copper as they supply much the larger part of the metal sold in the world's markets.

The most important sulphide mining districts are Butte, Mont.; Bisbee, Ariz.; Bingham Canyon, Utah; Ely, Nev.; Ducktown, Tenn., and Shasta County, Cal. In the Butte district of Montana, the greatest copper producing territory in the world, the ores are mainly secondary sulphides in fissure veins. More than half are chalcocite and considerably less than half enargite, although the proportion of the latter is increasing with the depth. With these are bornite, covellite and cupriferous pyrite. The primary ores of this region were chalcopyrite and pyrite. At deep levels (2,800 feet) are found masses of primary chalcocite, far below the zone of secondary enrichment. In Arizona three-fourths of the copper ores are sulphides. At Bisbee occur large masses of primary ore, but in the other districts the replacement of the original chalcopyrite and pyrite with chalcocite has been practically complete. In the Globe district the primary ores — pyrite and chalcopyrite — occur in commercial quantities, but the largest output is from the secondary deposits of chalcocite on deeper sulphides. In the Jerome district the important ore is primary chalcopyrite. At Bingham, Utah, there are large replacement deposits of pyrite, chalcopyrite, sphalerite and chalcocite, with some bornite and primary enargite. In some places covellite and tetrahedrite are found with chalcopyrite. At Ely, Nev., there are extensive replacements of chalcopyrite by chalcocite, and also bodies of chalcopyrite enriched with chalcocite. At Ducktown, Tenn., the primary ores are pyrite, chalcopyrite and bronite. The paying ore bodies are secondary chalcocite, with secondary chalcopyrite at a lower level — with some covellite, bornite and chalcanthite. In the Shasta copper belt of California large bodies of massive sulphides are found along the borders and within the areas of eruptive rocks, chiefly pyrite and chalcopyrite, with chalcocite below; and some bornite and tetrahedrite.

Examples of replacement of pyrite by chalcocite are found in every important district producing sulphides. The pyrite first becomes coated with a black stain; later the chalcocite penetrates it along cracks and fissures, and finally the whole becomes a mass of sooty black chalcocite.

At some of the sulphide mines all of the ore goes directly to the roasting furnace. At other mines where the ore is of lower grade it is first concentrated by mechanical means — screening, crushing and separating on jigging tables. The flotation process (q.v.) is particularly adapted to the concentration of sulphide ores, which are difficult to wet, and hence have a greater tendency to float, a tendency which is largely increased by treating them with oil. At other mines the ore is crushed to a diameter of one-fourth of an inch and leached with a solution of sulphuric acid, made on the spot by the burning of pyrite.

Treatment of Concentrates.— These are usually roasted in mechanical roasters, the most approved type being the improved McDougal furnace. The chemical action is the change from the sulphide condition to the oxide. The iron sulphide present also becomes the protoxide and then the sesquioxide. After roasting to, say, 7½ per cent sulphur content, the product is fused in reverberatory furnaces to form matte running usually 40 per cent to 50 per cent copper, and slag running 0.30 per cent to 0.67 per cent copper, which is usually thrown away as valueless. The matte is, as a rule, converted without being allowed to cool between reverberatories and converters.

Treatment of Lump Ore, Etc.— Ores are treated in blast furnaces, using coke as fuel in greater or less amounts, according to the smaller or larger content of pyrite in the ore. The smelting generally practised in the United States is known as the «semi-pyritic» and it takes advantage of the fuel value of the sulphides in the ore, as far as possible.

The fines are briquetted before charging them into the blast furnace, wherever suitable bonding material is obtainable, at low cost;— for example, slimes from the water concentration of the copper ores. In some localities the fines are sintered and in others nodulized to prepare them for blast furnace treatment. The resulting matte and slag are treated in ways similar to those obtaining in reverberatory smelting.

Converting.— The most common type of converter is the «trough» converter, with rows of tuyeres along the back, entering the charge a few inches above the bottom. The linings are usually made of magnesite brick. The products of the converter are sulphurous gases which escape through the flues and stacks; slag which is returned to the blast, or reverberatory furnaces; and «blister» or converter copper, which is either cast in pigs or anodes for electrolytic refining and the extraction of gold and silver values. For refining, see ELECTRO-CHEMICAL INDUSTRIES.

The improvements in recent years in the sulphide smelting have consisted in the adoption of mechanical roasters, the arrangement of the furnaces so that the product can be transferred from one department to another with minimum loss of heat and with the least possible handling, and the enlargement of the smelting units; for example, some reverberatory smelting furnaces now have a hearth measurement of 25 × 146 feet, and a smelting capacity of over 1,000 tons daily. Blast furnaces may now be built of unlimited length, the largest measuring 56 inches by 87 feet at the tuyeres with a daily capacity of 3,000 tons of charge; converters holding over 100 tons of matte have been built, but the most economical size seems to be of a capacity of about 80 tons. Other economical practices are the handling of slag, ashes, and other waste products in sluice boxes by water; the handling of materials generally by machinery; and the saving of waste heat from smelting furnaces; all the modern appliances for handling materials, water, steam, electricity and compressed air are called upon to assist in the operation of modern plants. Fuel oil and pulverized coal have been applied to reverberatory furnaces with great success in recent years. Developments looked for in the near future are the substitution of electric furnaces for the blast furnaces and an extension of the hydro-metallurgical processes.

The industry is prosecuted on a gigantic scale in the United States; the amount of capital invested is enormous, the average cost of a sulphide smelting establishment being $1,000 for each ton of ore treated daily. The largest plant constructed to date (1919) is the Anaconda Reduction Works at Anaconda, Mont., having a daily capacity of 18,000 tons of ore and producing about 15 per cent of the world's output of copper. A brief description of this smelter will give a general idea of the operation of a modern copper sulphide smelting plant, and the immense size of the plant. The copper ores, delivered on the «high line» by the Butte, Anaconda and Pacific Railway, are first enriched by mechanical concentration. In this process the useless part of the ore is separated from the valuable portion by making use of differences in specific gravity, the useless part being sluiced to the dump and the 3 per cent of copper in the ore becoming 8 per cent in the concentrated product.

The fine portion of this product is roasted, to remove 80 per cent of its sulphur, and is then smelted in reverberatory furnaces. The coarser portion goes to the blast furnaces, in which the burning off of 60 per cent of the sulphur and the melting of the charge are done in one operation. The reverberatories and blast furnaces produce matte (the copper content of which ranges from 40 to 50 per cent), and make slag as a waste product which is sluiced to the dump. The matte is treated in converters, which deliver an impure copper. The last stage is reached in the refining furnaces, which turn out the commercially pure metal; and this is shipped to the company's electrolytic plants at Great Falls, Mont., and Perth Amboy, N. J., where the silver and the small amount of gold are separated. The metals are then marketed.

The zinc ore is increased from an assay of 12 per cent zinc to 32 per cent by mechanical concentration. The metallurgical treatment of this concentrate is conducted at the company's plant in Great Falls, except as noted under the subject of roasting.

Bibliography.— Hofman, H. O., 'Metallurgy of Copper' (New York 1914); Peters, E. D., 'Principles of Copper Smelting' (New York 1917); Read, T. T., editor, 'Recent Copper Smelting' (San Francisco 1914); Wiard, E. S., 'The Theory and Practice of Ore Dressing' (New York 1915). The details of localities and individual copper mines are to be found in Weed's 'The Mines Handbook' published annually in New York.

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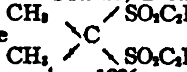
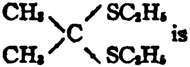
SULPHIDES, compounds of sulphur with some other element, constitute a large and important group of minerals. Pyrite and Marcasite, of the same composition (FeS_2) but differing in crystal form are probably the most abundant and widely disseminated sulphides. They are of no value as ores of iron but are largely used in the manufacture of sulphuric acid. The sulphides are the most important group of ore minerals and include the lead ore Galena (PbS), the zinc ore Sphalerite (ZnS), the silver ore Argentite (Ag_2S), the copper ores Chalcocite (Cu_2S), and Chalcopyrite ($CuFeS_2$), the quicksilver ore Cinnabar (HgS), the magnetic iron sulphide Pyrrhotite (FeS) which is often nickel bearing, and many other ores of lesser importance. See PYRITE; GALENA.

SULPHINDIGOTIC ACID, or INDIGOTIN DISULPHONIC ACID, an amorphous blue solid substance, having the chemical formula $C_{16}H_8N_2O_2(SO_3H)_2$, and prepared by heating indigo with fuming sulphuric acid. It is readily soluble in water and in alcohol. It has acid properties, and its salts are sparingly soluble in water. The sodium salt is known commercially as indigo extract, indigo-carmine, or soluble indigo. As the color is not fast it is now seldom used as a dyestuff.

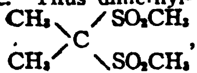
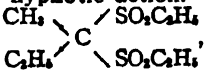
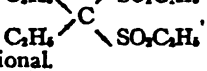
SULPHINIC ACIDS, organic acids containing the group $SO(OH)$, with the sulphur united to a carbon atom. Methane sulphinic acid, for example, which is prepared by the action of sulphur dioxide upon zinc-methyl, $Zn(CH_3)_2$, has the formula $CH_3.SO(OH)$. The sulphinic acids, in general, may be prepared by the action of zinc dust upon ethereal or alcoholic solutions of the chlorides of the sulphonic acids; and the sulphinic acids of the fatty series may be prepared (as in the foregoing example) by the action of the dioxide or trioxide of sulphur upon zinc alkyls. They oxidize into sulphonic acids (q.v.).

SULPHITES. See SULPHUROUS ACID.

SULPHOCYANIC ACID, or THIOCYANIC ACID, a substance having the chemical formula $HS.CN$ for the normal form. The acid form, $HN.CS$, has not been isolated but its ethereal salts have been recognized, and possessing powerful acid properties. The hydrogen that it contains can be replaced by bases, with the formation of a series of salts known as sulphocyanides or thiocyanates, most of which are soluble in water. Potassium sulphocyanide, $KSCN$, may be prepared by the direct combination of sulphur with cyanide of potassium, KCN. The ammonium salt $(NH_4)SCN$, is obtained (together with ammonium sulphide) when carbon disulphide is heated with an alcoholic solution of ammonia. The ammonium salt is found abundantly in gashouse liquor. The sulphocyanides of the heavy metals are usually prepared by fusing them with the sulphides of the alkaline metals, preferably potassium, by double decomposition. The free acid may be prepared by heating small quantities of mercury sulphocyanide in a stream of dry sulphuretted hydrogen gas; but its preparation in this manner is more or less dangerous, as it is often attended by explosions of some violence. A dilute solution may be obtained by distilling an excess of a sulphocyanide with dilute sulphuric acid. The pure acid is a colorless liquid at ordinary temperatures, with a strong characteristic smell. By the action of a freezing mixture of snow and salt, it may be obtained in the form of crystals. When heated it decomposes into hydrocyanic acid (HCN) and persulphocyanic acid ($H_2C_2N_2S_3$). Dilute aqueous solutions of sulphocyanic acid are stable at ordinary temperatures, but the anhydrous acid gradually passes into the polymeric substance known as disulphocyanic acid, $H_2S_2C_2N_2$. Disulphocyanic acid, when pure and freshly prepared, is a waxy yellow substance, nearly insoluble in water. It hardens with age, and upon the application of heat it is converted into ordinary sulphocyanic acid. Trisulphocyanic acid is not known except through its methylic salt ($Me_3S_3C_3N_3$), obtained (with methyl triocarbamide) by heating methyl sulphocyanide to 356° F.

SULPHONAL, Diethylsulphone Dimethylmethane 
$$\begin{matrix}CH_3 & & SO_2C_2H_5\\ & \diagdown\!\!\!\!\diagup C \diagup\!\!\!\!\diagdown & \\ CH_3 & & SO_2C_2H_5\end{matrix}$$
, was discovered by Baumann in 1886, and introduced into medicine as an active hypnotic in 1888. It is prepared by the condensation of a mixture of ethylmercaptan and acetone in the presence of hydrochloric acid or zinc chloride. Under these conditions dimethyl diethyl mercaptole, 
$$(CH_3)_2C(SC_2H_5)_2$$
is obtained, which yields sulphonal upon oxidation with potassium permanganate. On account of the difficulty experienced in handling ethyl mercaptan, the use of sodium thiosulphonate $C_2H_5S.SO_2ONa$, in the presence of hydrochloric acid, has been suggested. This compound will also yield a mercaptole with acetone, and from mercaptole sulphonal may be obtained by oxidation.

Sulphonal crystallizes in colorless prisms, It melts at 125° — 126° C., and boils without decomposition at 300° C. It dissolves in 15 parts of boiling water, and in 500 parts of water at 15° C., but is freely soluble in boiling chloroform, alcohol, acetone, benzene and toluene. In doses of 15–30 grains sulphonal will usually induce sleep, although the time required for its action shows wide individual variations. It has been classed among the safe and dependable hypnotics, as it induces quiet sleep with no marked after-effects, but its continued use has in some instances developed chronic poisoning with fatal consequences.

The hypnotic action of sulphonal has been traced to the ethyl groups present in its molecular structure. It has been definitely shown that of the compounds closely related to sulphonal those containing no ethyl groups are not physiologically active. Thus dimethylsulphone dimethyl methane, 
$$(CH_3)_2C(SO_2CH_3)_2$$
, has no hypnotic action. On the other hand trional, 
$$(CH_3)(C_2H_5)C(SO_2C_2H_5)_2$$
, is more active than sulphonal, and tetronal, 
$$(C_2H_5)_2C(SO_2C_2H_5)_2$$
, is even more active than trional.

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SULPHONIC ACIDS, a series of acids, both organic and inorganic, distinguished by containing the monovalent radical, $SO_2.OH$, also written, SO_3H. The inorganic members of the group may be regarded as derived from $SO_2.OH.H$ by replacing the final H by a monovalent atom or radical, such as chlorine; or, more generally, from *n* molecules of $SO_2.OH.H$, by replacing the *n* final H atoms by a single *n*-valent atom or radical. Chlorosulphonic acid, $Cl(SO_2.OH)$, is an example of such an acid. It may be prepared by the direct combination of sulphur trioxide, SO_3, with hydrochloric acid, and also in various other ways. The number of hydrogen atoms replaced depends on the strength of the acid used and on the temperature at which the action is carried on. In organic sulphonic acids, the $SO_2.OH$ group is joined, by means of its own sulphur atom, to a carbon atom in some organic base. There arise from such combination two classes of sulphonic acids, the aliphatic and the aromatic. Only the latter series is of importance in the arts. The sulphonic acids of aromatic compounds play an important part in the coal-tar color industry, and they may be readily prepared by digesting aromatic compounds with either sulphur trioxide, sulphuric acid, or chlorosulphonic acid. The aromatic sulphonic acids are usually prepared by boiling the sulphonation product with an excess of calcium carbonate, or, preferably, barium carbonate. The barium sulphate precipitated is separated out by filtering. The filtrate contains the barium (or calcium) salt of the sulphonic acid. To this filtrate sulphuric acid is added drop by drop until no more precipitate forms. The solution is again filtered, and the filtrate evaporated to dryness, the acid appearing either as a syrupy liquid or in crystals, according to its constitution. If calcium carbonate has been used traces of it will remain in the acid, and must be removed by adding alcohol, filtering, and evaporating the alcohol with gentle heat. Where the result contains two sulphonic acids they are usually separated by conversion into sulphonic chlorides by the addition of phosphorus pentachloride (or oxychloride) and crystallized — when they assume their distinctive forms.

The aromatic sulphonic acids are strongly acid in reaction, and are generally highly soluble in water, the crystalline forms as a rule being hygroscopic. When heated, they decompose gradually without melting. They are manufactured in large quantity to be converted into phenols — readily accomplished by fusion with caustic alkalies. Consult Benedikt, 'Chemistry of the Coal Tar Colors.'

SULPHOVINIC ACID, or ETHYL-SULPHURIC ACID, *in chemistry,* monoethyl sulphate, $C_2H_5.HSO_4$, or acid sulphate of ethyl. It consists of sulphuric acid, for one of whose replaceable hydrogen atoms the organic radical "ethyl," C_2H_5, has been substituted. Sulphovinic acid may be prepared by heating a mixture of equal parts of strong sulphuric acid and absolute alcohol to about 212° F., allowing it to stand for four hours, and then diluting the solution with water, and saturating it with barium carbonate, or as an alternative, lead carbonate. The excess of sulphuric acid is thereby precipitated as barium sulphate, and the filtrate (which contains the barium salt of sulphovinic acid) is then evaporated to crystallization. The crystals of barium-ethyl-suphate thus obtained are redissolved in water, and the barium is removed by the addition of an exactly equivalent quantity of sulphuric acid, the filtrate from this operation being subsequently evaporated in a vacuum over a powerful drying agent, such as calcium chloride. Pure sulphovinic acid is a colorless, syrupy liquid, which mixes readily with water and with alcohol, but which is insoluble in ether. It is a strongly acid substance, containing one atom of replaceable hydrogen; and it forms, with various bases a series of crystallizable salts which are all readily soluble in water. Its aqueous solution decomposes slowly in the cold; and when heated, it decomposes with the liberation of alcohol and free sulphuric acid. Its alcoholic solution when heated yields ether and sulphuric acid. It combines with the salts of various organic acids, with the formation of the corresponding ethyl ethers, or esters. Di-ethyl sulphate, $(C_2H_5)_2SO_4$, is a compound of this character, which is most conveniently prepared by slowly distilling absolute alcohol with concentrated sulphuric acid in a vacuum. The distillate separates into two layers, the lower of which consists of pure di-ethyl sulphate. It is an oily liquid with an odor resembling that of peppermint. It is insoluble in water, in which, however, it decomposes slowly. If di-ethyl sulphate is heated in water it decomposes rapidly into alcohol, sulphuric acid, and sulphovinic acid.

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